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APATHETIC THYROIDISM AS DISTINCTIVE TO ACTIVATING THYROIDISM

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So striking and so impressive as to the seriousness of the disease are the evidences of activating thyroidism in the youthful that warnings of the dangers and risks attached to this condition are almost unnecessary. The striking features of active thyroidism are self-evident. All of the clinical evidences of the presence of active thyroidism are well calculated to produce in anyone's mind an awesome respect for the immediately serious possibilities associated with it. The fright-struck features, the staring eyes, the flushed skin, the tremulous hands, the rapid pulse, the pounding heart, and the ceaseless activation are symptoms almost certain to stimulate in any observer a wholesome respect and even apprehension of the capabilities for disaster and destruction which are present in this type of thyroidism.

Activating thyroidism has occurred in our experience at any age, even up to the late years of life, but the affection is most common in young individuals, and perhaps is in some measure so strikingly evident when it occurs in a young and resilient organism, because of their ability to respond most vigorously to the effects of an elevated metabolism and increased combustion.

There exists, however, another type of thyroidism which is much less striking in character than the activating type, but

which has, though less strikingly, none the less certainly, very possible consequences of serious outcome when patients afflicted with this type of thyroidism are subjected to any considerable degree of stress.

In discussing this type of thyroidism, we have termed it "apathetic thyroidism," in contradistinction to the activating type. Rarely are patients with this type of thyroidism flushed. Their features are not anxious, their eyes often show little or no stare. When seen in bed, their general appearance is one of considerable repose. There are no ceaseless movements of activation. They are frequently pigmented, of prematurely senile appearance, and have often lost considerable amounts of weight. There is frequently but little tremor, and often, particularly when the thyroidism is of the primary or exophthalmic type, but little if any enlargement of the thyroid. The consistency of the small thyroids of this type is one of firmness. The clinical history in cases of this type is one which admits of the probability of the existence of a moderate degree of thyroidism over a considerable period of time. The basal metabolic readings in thyroidism of this type (apathetic) in contradistinction to the readings in that of the activating type are usually of relatively low levels, such as +30, +35, and +40, and not infrequently, because of the atypical features of this type of thyroidism it is often not recognized until it has existed for some weeks or months.

It is this type of thyroidism which is so frequently seen in association with cardiac decompensation, the combination of which produces the clinical picture which we have termed "thyrocardiac."

We are particularly interested in stressing the existence of this apathetic type of thyroidism; and, in order that it may be more universally appreciated by those who are not dealing with thyroid patients in any considerable numbers, and so perhaps diagnosed earlier, and, too, in order that the latent seriousness of this state may be appreciated.

We wish particularly to warn that patients with this type of thyroidism are much poorer operative risks than they appear to

be, and that it is in this type of thyroidism particularly that one is often led into a false sense of safety because of the absence of signs of thyroid activation, and so tempted to complete extensive procedures upon the thyroid gland (complete subtotal thyroidectomy), only to have the patient fail to arouse from the anesthetic and continue on to death in an unconscious state, or to recover from the anesthetic later to pass into a peaceful unconsciousness and die with no evidence of activation and intense intoxication, as so constantly occurs with the typical activating thyroidism as seen in the youthful.

We have more than once operated upon such patients who have shown no impressive signs of thyroidism with relatively low basal rates and with pulse-rates of 120 or under. These patients have not infrequently run extremely deceptive operative courses. We have too often operated upon a patient with such an apathetic type of thyroidism, with a pulse never ranging under 120 and a pulse-pressure also well within reasonable limits, yet have seen several such patients die postoperatively in peaceful unconsciousness in spite of all our endeavors to support them.

We feel now, after having operated upon several thousand patients with thyroidism that we can be quite certain of segregating and cautiously approaching the patient with activating thyroidism of a dangerous type. We have been less certain, however, of segregating and cautiously approaching patients with this apathetic type of thyroidism. Practically all of the mortality in the surgery of thyroidism in our hands today is confined to too extensive procedures upon patients with thyroidism of the apathetic type. We believe that in our hands the mortality of the surgery of toxic thyroids is confined now, with the exception of surgical accidents, to patients with this misleading, non-striking type of thyroid intoxication.

All of the patients with this type of thyroidism who have died in our hands following surgery have been unwisely submitted to complete subtotal thyroidectomy. We must assume, we believe, that had we more certainly appreciated the seriousness of this type of thyroidism and submitted these patients

to a more limited procedure (first stage hemithyroidectomy), there is a good chance that they would not have died.

We must admit that after appreciating and realizing the seriousness of this apathetic type of thyroidism, we have still in two instances been misled by their apparent good condition upon the table while being operated, into carrying out a complete subtotal thyroidectomy, with fatal outcome.

It is also an unfortunate fact that since the fatal postoperative states which so unexpectedly follow extensive operative procedure upon the thyroids of patients with this type of thyroidism are not associated with activation and agitation, as is true of the activating type of thyroidism, particularly in youth, there are no postoperative measures which appear to be available in the impending fatalities of apathetic thyroidism. If one has a severe postoperative thyroid storm following subtotal thyroidectomy upon a patient with the typical activating type of thyroidism, one may endeavor by drugs, particularly morphia, to control the excessive activation. With the quiet deepening apathy, however, which is associated with the fatal postoperative outcome in thyroidism of the apathetic type, there is no benefit to be derived from morphia, and one cannot help wishing for a drug contrary to the action of morphia with which to rouse them from progressing helplessly into the fatal unconsciousness with which they reach their end.

The mortality rate in 1223 goiter operations in the clinic last year was 0.27 per cent. including goiters of all types; on toxic goiters, 0.16 per cent. While perhaps this is as low a mortality rate as we shall be able to obtain and perhaps, at times, it may be slightly higher, we feel sure that with proper organization, cautious approach, and careful postoperative care the mortality of toxic goiter as it is managed by us today can at least be kept at or under $\frac{1}{2}$ of 1 per cent. Since a good part of this mortality rate as it exists today is the result of an improper estimate of the seriousness of these patients with the misleading thyroidism of apathetic character, we have assumed the position ourselves, and wish to urge upon others dealing with thyroid operations, that patients with thyroidism of the

apathetic non-activating type, even though apparently of not marked degrees of intensity, be considered as dangerous risks, and that in spite of their apparent good condition upon the table and during the operation, they be viewed in general as bad risk cases, approached with caution, and undertaken for the most part in two-stage procedures.

DIAGNOSIS OF SUBSTERNAL GOITER

HOWARD M. CLUTE

ALTHOUGH it is true that goiters which are completely substernal are but rarely seen, goiters that have a tendency to substernal projections of one or both lobes with pressure upon the trachea are frequently seen. The various symptoms and signs which accompany these types of substernal goiter, however, can well be reviewed and it is the purpose of this brief note to summarize again the clinical findings which accompany complete and incomplete substernal goiter.

Endemic goiter is the type of thyroid gland pathology which is most naturally suited to substernal descent. As the various colloid adenomata develop in the lower pole of each side of this goiter a substernal projection from one side is quite an easy and natural event. The next goiter in frequency of substernal extension is the single or fetal adenoma. This type is less commonly found in the substernal region, perhaps because it is a much less common type of goiter. Malignancy of the thyroid gland can, of course, extend substernally, and, furthermore, it may develop in an adenoma of the thyroid, which before it was malignant was substernal in position.

Exophthalmic goiter with a typical hyperplastic thyroid gland is never in our experience completely substernal. With its very large hyperplastic lobes, however, it is not at all uncommon to find that the lower pole is somewhat subclavicular in position. This is not a true substernal extension, but simply a low-lying pole due to the tremendous size of the hyperplastic lobe lying in the neck.

The reason that certain goiters become substernal while others remain in the neck is very uncertain. It was pointed out by Dr. Lahey some years ago, however, that there are many

factors tending to produce a substernal extension of a thyroid adenoma. If the adenoma for example lies at the lower pole of the thyroid gland, then the constant pressure of the prethyroid muscles upon the adenoma during the movements of swallowing is always tending to push it into the superior mediastinum. Furthermore, although the superior mediastinum is only a potential cavity, nevertheless it is filled with nothing but fine areolar tissue which offers no resistance to the descent of the thyroid adenoma. Finally the fact that the adenoma has descended partly through the superior thoracic strait into the superior mediastinum is another reason for its tending to remain there since it is much easier for it to go downward from this position than it is to go upward out of the bony opening.

Multiple colloid adenomatous goiter then or the so-called "endemic goiter" is the type of thyroid enlargement which we most commonly expect will produce substernal projection. Occasionally this type of goiter may have one whole lobe almost completely in the superior mediastinum but this is rare. The single adenoma, which lies at the lower pole of the gland not infrequently, will descend into the superior mediastinum. These two types of thyroid pathology are the ones which most commonly produce substernal goiters.

Aberrant goiters occasionally occur in the superior mediastinum as they may occur in other parts of the neck, most commonly along the jugular vein on either side of the neck, but this type clinically cannot be distinguished, in our opinion, from the multiple colloid adenomatous goiter which has become somewhat substernal, and until it is removed and studied microscopically cannot be definitely recognized as aberrant goiter.

The important points in the *patient's history* of the goiter which she has noted for some years are very few, but they are of considerable significance. Not infrequently the patient will say that many years before she had a lump in the lower part of her neck but the doctor cured it; or she will say that the lump which she used to have in the right side of her neck has now disappeared and it is only lately that she has noticed any trouble from her neck; or that for many years she was perfectly well in

spite of the fact that she had a goiter which has now disappeared. Such a history of a thyroid tumor in the neck which disappeared, either with treatment or without treatment, should lead one at once to suspect the possibility of an adenoma which has become substernal and thus has gone out of sight. In other cases, the history will show that a goiter had been present for many years without causing any difficulty, but that it has recently begun to cause pressure upon the trachea to a certain degree so that it occasionally makes it difficult for her to get sufficient quantities of air. In many instances the history will reveal nothing that can be related to the substernal position of the goiter.

It may be said that there is no symptom or set of symptoms which is absolutely pathognomonic of substernal goiter. There are, however, many symptoms which are so suggestive of the possibility of substernal goiter that they may well cause one to look further into the patient's case, and attempt to prove or disprove the presence of substernal goiter. Certainly the most important group of symptoms associated with substernal goiter are those due to some pressure upon the trachea which either narrows it in calibre or deviates it from its usual central position or both. It is almost impossible for a goiter of any size to become substernal without deviating the trachea from the midline and with any marked tracheal deviation from the midline there is bound to be some narrowing of the tracheal tube (Fig. 480). It is, therefore, obvious that with substernal goiter, symptoms will arise most commonly from pressure of the goiter upon the trachea and the resulting trachea deformity. In mild cases these symptoms consist simply of a persisting, active, annoying, non-productive cough. Examination of the chest reveals no evidence of any pulmonary disease. Examination of the larynx and throat will reveal nothing more than some irritating laryngitis. In some patients who have a very marked deviation of the trachea coming on slowly over a long period of years it is very interesting to note the entire absence of all symptoms of tracheal pressure in spite of the presence of marked tracheal deformity. In other patients who have much less tracheal deviation which has, however, arisen much more rapidly, there is frequently a

prominent cough and much tracheal irritation and partial obstruction.

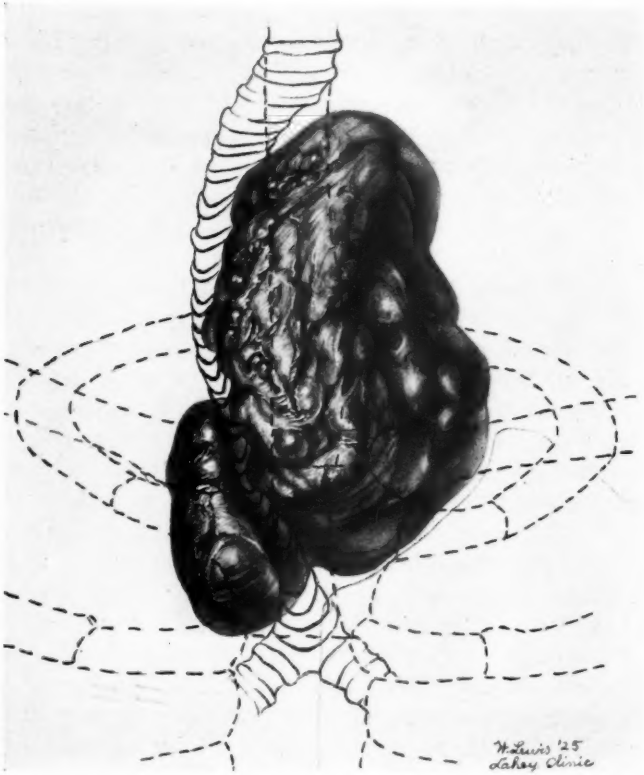


Fig. 480.—Schematic drawing showing the deviation to one side of the trachea which is caused by a large adenomatous goiter of the left lobe with a partial substernal extension. Note the extreme narrowing of the caliber of the trachea as well as its deviation from the midline to the right and behind. Note furthermore that on the right side of the trachea there is a small adenomatous lobe which is completely substernal. Such a substernal lobe would be suspected when it was impossible to feel the lower pole.

In some patients with marked tracheal deviation from the midline there is very marked stridor. This means, of course, that the trachea is not only deviated from the midline, but its

caliber is also diminished by the goiter. Not infrequently, in endemic goiter in which both lobes are partly substernal the trachea will be markedly narrowed by the pressure of each lateral lobe of the trachea. In other cases as Dr. Lahey has shown the stridor will arise only when the patient's head is in such a position that the trachea is bent over the substernal tumor and in that way distinctly narrowed; for example a person having an adenoma of the left lobe of the thyroid which is completely substernal would very possibly have marked stridor when they bent their heads to the left. In this way they pull the trachea over the adenoma whereas they would have no stridor, but on the contrary, a relief of their obstruction if they bent their heads to the right and carried the trachea away from the adenoma. In certain rare cases we see extreme evidence of tracheal pressure with marked choking which threatens the patient's life. In our experience these patients with extreme choking from tracheal pressure are very rare and very unusual, and in fact have been limited to perhaps one or two patients in our entire experience. Tracheal pressure from substernal goiter is the most common symptom, but as a symptom dangerous in its significance it is extremely unusual. Only once or twice in our entire experience with over 7000 goiter operations have we seen patients who we feared were in danger of death from tracheal pressure of a non-malignant goiter.

The occurrence of hoarseness in a patient who has otherwise been well and had no difficulty is sometimes significant of the presence of a substernal goiter. When hoarseness occurs, therefore, without particular cause, laryngeal examination should be carried out. If this shows that there is a paralysis of one of the recurrent laryngeal nerves and if there is no thyroid tumor to be felt in the neck, then certainly one should not be content until they had had an *x*-ray to prove or disprove the possibility of a substernal goiter as the cause of the recurrent laryngeal nerve paralysis. Difficulty in swallowing rarely occurs in substernal goiter. We have, however, seen it occasionally when a substernal goiter has become larger quite rapidly, as for example, from a sudden hemorrhage into an adenoma. This has been

very rare, however, and it is our experience that substernal goiter does not affect swallowing to any degree.

In certain instances, the first evidence we have that substernal goiter may be present is the development of hyperthyroidism in a patient who has no visible or palpable goiter. Occasionally we have seen patients who had unquestionable hyperthyroidism and yet we could find no thyroid enlargement in their neck, who, on *x*-ray showed a definite substernal adenoma which was later proved to be the cause of their hyperthyroidism.

On the examination of a patient, there are many more things which point to the presence of a goiter lying beneath the sternum than there are in the history or in the symptoms. The first thing which one may note in certain instances of substernal goiter is a pronounced swelling at the base of the neck. On examination it is evident that there is a tumor to be felt at the sternal notch which with slight pressure descends out of reach into the chest. In such a case coughing or straining will make the tumor rise up from the superior mediastinum into the root of the neck where it can be readily viewed and even palpated. Such a swelling, freely movable, in this position, is almost always a substernal adenoma. In a case of this type one is unable to palpate the lower pole of the thyroid gland on the side from which tumor originated, which confirms the diagnosis of a substernal adenoma.

In certain rare instances, patients are seen who have a tremendous dilatation of the veins over the front of their neck and more particularly over the upper, anterior chest wall. This may be due to a very large substernal goiter interfering with the return flow of blood through the superior vena cava and in that way producing dilatation of the veins in the neck as a secondary return circulation is being established.

In many instances the final proof of the presence of a substernal tumor will depend entirely upon the *x*-ray evidence, and an *x*-ray examination must never be overlooked in any case of suspected substernal goiter. *x*-Ray should be taken with particular emphasis on the showing of the trachea. Not infrequently no goiter shadow will be seen in a substernal goiter case

by *x*-ray; but if the *x*-ray is so taken that it will show both the anteroposterior and lateral views of the trachea, then the substernal goiter will be recognized through the deviation of the trachea whether the tumor itself be visible or not (Figs. 481, 482).

The *x*-ray in substernal goiter will in certain instances, show the shadow of the goiter itself. These cases are more commonly

Fig. 481.—*x*-Ray of the trachea which shows a marked deviation of the trachea to the right side. In the original plate the slight shadow of the larynx can also be detected and can be seen to be rotated to the right.

patients in whom there is a very large substernal tumor, or patients who have had this substernal goiter for a long time and have developed areas of calcification in it. In many instances, however, even though there is a marked substernal extension of the thyroid gland, no direct evidence of this will be shown by *x*-ray. The important *x*-ray findings in substernal goiter are those related to the position of the trachea.

When a goiter descends behind the sternum it may deviate the trachea from the midline to any position. We may expect to find the trachea to either the right or the left of the midline; it may go posteriorly from the central position or it may be pushed anteriorly by a retrotracheal extension of the thyroid gland.

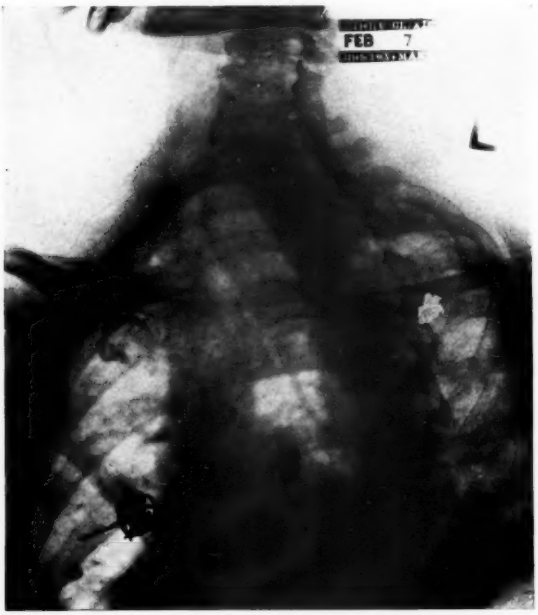


Fig. 482.—Lateral view of the trachea shown in Fig. 480. Note that the trachea at about the upper border of the sternum is bent sharply forward by a retrotracheal extension of the goiter. When this anterior displacement of the trachea is seen in the lateral view lower in the mediastinum we may expect to find a marked substernal extension of the thyroid behind the trachea.

Views must be taken, therefore, which will show not only the lateral deviation of the trachea, but also the anteroposterior position of the trachea. In certain cases of substernal goiter the anteroposterior view of the trachea will show no lateral deviation from the midline, and were this the only view to be depended upon, the true situation would not be suspected. In the

lateral view, however, it not infrequently is found that the trachea is pushed markedly backward to the vertebral column or even pushed off to one side and beside the body of the vertebral bones. In other instances, the trachea will come down in the midline and in the proper anteroposterior position to the upper border of the sternum and then will be pushed markedly forward by a retrotracheal substernal extension of the thyroid which would in no way be suspected without adequate lateral tracheal views.

If *x*-rays of the superior mediastinum show a definite goiter in the superior mediastinum as an encapsulated tumor which is pushing the trachea to one side or the other then we may be quite certain of the diagnosis. If, however, the trachea is markedly deviated from its normal central position, although we cannot see any enlargement of the thyroid in this substernal region, we may strongly suspect it from the deviated position of the trachea alone.

Dr. George J. Heuer, writing in the Archives of Surgery for January, 1929, on "Thoracic Tumors," has listed a very satisfactory classification of various tumors of the chest and thorax. Of the tumors which he lists as possibly occurring in the thorax, and particularly in the mediastinum, there are relatively few. First he speaks of dermoid cysts. These he says arise near the hilum in the mediastinum. They do not affect the trachea as a rule and they show in *x*-ray plates as clean cut shadows. Second are other cysts such as the echinococcus which are very rare in their occurrence. Third, rare connective-tissue tumors such as lipomas, fibromas, chondromas, etc. for which there are no particular diagnostic features to be obtained by *x*-ray. They are, however, very rare, which is a point of considerable importance in diagnosing them. Next he considers malignant tumors of which there really are but a few; the lymphoblastoma, sarcoma, and carcinoma. Tumors of the lungs, in our experience, are not confused with substernal goiters. Tumors of the pleura are likewise so rare and so unusual and so placed that they are not confused with substernal goiters. Tumors of the bony chest wall are likewise not commonly in the area of substernal goiter and in our experience, are extremely rare and are not likely to be confused

with substernal goiter. The most common thoracic tumor that one may see aside from thyroid tumors, then, is a dermoid cyst, and since these arise near the hilum of the lung while the adenoma of the thyroid is in the superior mediastinum, since these are clear-cut shadows, while the thyroid adenoma often does not show at all, since these dermoid cysts do not affect the trachea as a rule while the substernal thyroid adenoma affects the trachea almost always there should be but little difficulty in differentiating the one from the other. Furthermore, the fact that in our entire experience we have seen but two dermoid cysts of the mediastinum makes it extremely unlikely that a superior mediastinal tumor will be anything else than a thyroid adenoma.

THE SIGNIFICANCE OF THE VARIOUS SIGNS AND SYMPTOMS FOLLOWING SUBTOTAL THYROIDECTOMY FOR HYPERTHYROIDISM

LEWIS M. HURXTHAL

THERE are numerous minor signs or symptoms which occur simultaneously with the marked improvement following subtotal thyroidectomy for hyperthyroidism. One is impressed with the similarity of such complaints in following a large number of patients at intervals throughout the first few years after operation. Most of them suggest the possibility of one of the more serious sequelæ which may occasionally follow subtotal thyroidectomy, namely: postoperative myxedema, tetany, laryngeal paralysis, persistent or recurrent hyperthyroidism. In most instances, however, these minor symptoms are of comparatively little importance, although they are very real to the patient. They are presented here with what we have found to be their relative significance and duration. For convenience these will be grouped under the heading which they suggest, but it is not to be inferred that they are necessarily related.

1. **Postoperative Myxedema.**—The clear-cut picture of postoperative myxedema presents no difficulty in diagnosis. As a rule, this condition appears within six months following operation. It is accompanied by a low basal metabolic rate, but the severity of the condition is not always in agreement with the basal rate obtained. In other words, there are many who will have a low metabolic rate without myxedema, and a few who will have unquestionable myxedema with a metabolic rate often found in normal people. In this group a diagnosis is often difficult and while a therapeutic trial of thyroid substance might prove the deciding factor, we have felt that unless there are clear-cut signs of myxedema, thyroid feeding is in most instances, unnecessary and ineffective.

In myxedema, falling hair is frequent, but it is also very common following thyroidectomy and invariably followed by a new growth within six months. Without other signs of myxedema, one can reassure the patient without hesitation that the hair will return.

Most patients with myxedema complain of sensitiveness to cold. Here again this is not in itself proof of deficiency of thyroid secretion. Patients with hyperthyroidism suffer from the heat, and owing to the rapid change following operation, many will complain of this symptom. This may be purely by way of contrast from an abnormal to a normal state. If the disease has been of long duration, the patient has formed habits in clothing and regulation of household temperature which following operation are found to be uncomfortable. Thus he feels cold in the same surroundings in which he formerly felt comfortable or warm. If thyroid is fed for this complaint, with no other evidence of myxedema, results are disappointing unless such a dose is reached which, while overcoming coldness, will produce the annoying symptoms of induced hyperthyroidism.

Puffiness of the eyelids is a common feature of myxedema, but also fairly frequent in patients with marked exophthalmos. It may persist for years following operation without other evidence of disturbed thyroid function.

Stiffness of the joints is often associated with spontaneous myxedema. The use of thyroid substance is wide-spread in the treatment of arthritis. Occasionally, patients with arthritis develop hyperthyroidism, and, as might be expected, increased stiffness has followed operation. In other instances, stiffness of the joints has appeared for the first time following removal of a toxic goiter. Presumably a mild arthritis preceded or began coincidentally with the onset of thyroid toxicity, and showed itself when the beneficial effect of increased circulation associated with hyperthyroidism was eliminated. Stiffness of the joints is comparatively rare in postoperative myxedema as we have seen it. For this reason we have been careful not to predict with any certainty the relief of this symptom with thyroid feeding.

Brittle finger-nails are usually found in marked myxedema.

but as a sign of postoperative myxedema it frequently fails. There are many people who have always had brittle nails without obvious cause, even during the height of the disease. When present as a diagnostic sign, the patient is usually so definitely myxedematous that they cease to be of help in diagnosis.

Dry skin is always suggestive of myxedema, especially if the axilla and palms are dry. On the other hand, one may be led astray at times if every case of myxedema is expected to show an abnormally dry skin. Dry hair, when not due to excessive heat or washing, is relatively important as a diagnostic sign.

Menstruation is often profoundly affected in disturbances of the thyroid. When there is excessive thyroid secretion present, menstruation is often suppressed. This may also be true when there is myxedema. On the other hand, excessive flowing may be present when there is insufficient thyroid output. Following operation it is not uncommon to have a patient complain of diminished or absent menstruation for several months, even though there was no history of altered flow during the disease. This may occur without myxedema. In postoperative myxedema, the rule is to have scanty periods which are restored to normal by administration of thyroid substance.

Dysmenorrhea is occasionally partially relieved during the disease and returns after operation. A few complain of it for the first time postoperatively.

A change in libido is occasionally mentioned by women following operation, without evidence of myxedema. A true estimate, however, is difficult to obtain. With men there is frequently diminished sex desire during the disease which returns to normal after operation. With postoperative myxedema, however, almost complete loss is frequently complained of. This may be fairly well overcome by treatment.

Another symptom so frequently mentioned is the inability to sustain muscular effort. This is particularly noticed by housewives. An attempt to do anything with the arms held upward is followed by extreme fatigue of the arm muscles. This may be present when the patient appears to be in excellent general condition without the slightest evidence of disturbed thyroid se-

cretion. As a rule, this rights itself within six to nine months following operation, but at times may persist longer and become a most distressing symptom.

The average gain in weight at the end of one year after operation is from 15 to 20 pounds. As a rule, the amount gained is about that lost following the onset of hyperthyroidism, but, of course, variations from this are common. Those who develop postoperative myxedema gain the greatest average amount of weight postoperatively.

All of our patients with hyperthyroidism are discharged with instructions to take plenty of rest and at the same time are advised to partake lightly of sweets and fried foods. If, following the first three or six months, it is desired to prevent further gain, a restricted diet is then prescribed. In most instances the weight can be controlled.

2. **Tetany.**—In active tetany following operation, Chvostek's or Trousseau's sign is almost invariably positive if the blood calcium is below 7.5 mg. The occurrence of muscular cramps, of course, suggests tetany, but we have failed to find lowered blood-calcium in any of these cases unless the other positive signs mentioned above have been elicited. Muscular cramps are so exceedingly common for the first six months following thyroid operations that their significance often becomes a problem for conjecture. We have often prescribed large doses of calcium, but here again the therapeutic result is difficult to determine. Curiously enough, this same phenomenon is not infrequently seen following thyroid administration in myxedema, particularly during the first few days of feeding.

3. **Persistent Thyroidism.**—The question of the presence of mild persistent hyperthyroidism frequently must be decided in a small percentage of cases. The clinical impression rather than the metabolism test should always stand first. It might be said that where there is considerable doubt as to the presence of persistent hyperthyroidism, it is usually absent and iodin will be of no help. Yet there is a small but definite group of patients which maintains that a few drops of Lugol's solution taken once or twice weekly make them feel better even though their met-

abolic rate may be entirely normal. In general, our experience has been that if there are easily palpable thyroid remnants, and if the metabolic rate is a high normal or above, Lugol's solution will prove, in most instances, partially effective and, in a few completely effective. Removal of remnants will usually give full recovery.

There is another small group which persist in showing an elevated metabolic rate, with no palpable remnants, in which iodin will not be beneficial. Some of these patients will have had all the usual clinical improvement following operation that the average case has. It is best to leave these patients alone unless they are losing ground. As a rule, there is often something atypical in their clinical picture which defies diagnosis.

4. **Recurrent Hyperthyroidism.**—The distinction between persistent and recurrent hyperthyroidism is often arbitrary. Any patient who has shown a normal metabolic rate along with a complete clinical cure at any one examination after subtotal thyroidectomy is considered to be a recurrent case.

As a rule in the latter type there is what appears to be a regrowth or hyperplasia of thyroid tissue along with toxic symptoms. Lugol's solution in moderate doses will be almost as effective in these cases—if it has not been taken for some time—as in untreated cases. One of the striking things in these cases, however, is that although there may be almost complete recovery, both clinical and metabolic, there still exists a residual toxicity, not always demonstrable by the usual clinical signs of hyperthyroidism but by an indefinite ill health—neurosis excluded—characterized by easy fatigue, failure to gain, and various minor symptoms which may seem of no importance. Removal of thyroid remnants in these cases, particularly if large, often produces some of the most remarkable results in thyroid surgery. This has particularly come to our attention in several cases complicated by heart disease who have been in congestive failure. A subtotal thyroidectomy having been performed and complete restoration to normal activities following for a time, the patient has returned with a recurrence of heart-failure. Removal of

remnants produced lasting benefit. Thus in such cases, removal of thyroid remnants should be seriously considered and performed if there is any doubt as to a residual toxicity.

As to the various signs and symptoms which help one out of the difficulty as to whether or not an elevated postoperative metabolic rate taken after two to three months represents thyroid toxicity, the usual manifestations of hyperthyroidism, if present in sufficient quantity to make a clear-cut picture, will, needless to say, suffice. But the clinical picture must be typical; otherwise one can easily be led astray. Tachycardia, palpitation, hypertension, nervousness, or failure to gain, with a poor appetite, are of no significance if present alone or together. Tremor may often be misleading; persistent or increasing exophthalmos is of no value. A good appetite characterizes the thyrotoxic patient so persistently that it may be said to be the rule. In the persistent thyrotoxic patient, gain in weight may take place frequently, while failure to gain or a loss of weight from an immediate and moderate postoperative gain may come about. A warm, moist skin in a postoperative patient should always be considered as suggestive of persistent toxicity. A wide range of pulse-pressure (60 mm. or more) on several observations in a patient whose systolic pressure is not over 160 mm. Hg must be accounted for, and is most commonly seen in toxic cases. If the latter mentioned signs are present in common with an elevated basal metabolism and palpable thyroid remnants, persistent thyroidism is present. Lugol's solution may be permanently effective in a few cases; if not, surgical removal of more thyroid tissue will be curative with rare exceptions.

If full account is taken of the patient's history of their behavior before the onset of thyroid toxicity, the question of doubtful recurrent or persistent hyperthyroidism can more often be settled by that than by too much attention directed to the basal metabolism or the patient's present complaints.

Little harm can be done in giving iodin solution to postoperative thyroid cases suspected of residual toxicity. This, of course, is not true of the unoperated case, where it should only

be used in preparation for operation. In fact, much improvement will often follow, and at times an apparently complete or spontaneous cure will result. But one must always be sure that no symptoms will arise if iodin is discontinued and that further operative procedures will not give an improvement far beyond anything that iodin can accomplish. We advise further removal of thyroid tissue if after a reasonable time iodin solution has not given maximum results. In cases with rapidly regrowing thyroid tissue, operation is the best plan to pursue.

5. **Laryngeal Paralysis.**—A fairly common complaint following subtotal thyroidectomy is weakness of the voice. This may be manifested by inability to speak loudly or by having the voice give out after a moderate amount of talking. For this reason singers must be told outright before operation that there may be trouble afterward. While some singers have noted no change after operation, a few have been unable to resume their occupation. This weakness is not accompanied by hoarseness and laryngeal examination reveals no paralysis of the vocal cords. In most instances the condition is not a permanent one and usually passes off within the first year after onset. Hoarseness without evidence of vocal cord paralysis is not infrequent. This may be associated with local edema following the trauma of operation. Nothing is found on examination except occasionally slight redness of the laryngeal mucous membranes.

Every case of hoarseness, however, should be carefully examined to exclude laryngeal paralysis if for no other reason than its prognostic significance. A bad prognosis, however, should not be given in all cases examined shortly after operation.

Summary and Conclusions.—Having followed nearly all cases of hyperthyroidism at three-month intervals for a year after operation, and a smaller number at yearly intervals thereafter, we have been able to study and evaluate the various minor signs and symptoms herein presented. Because of their similarity to some of the serious postoperative complications that occur, we believe it important to carefully follow the patients until such time as these conditions are likely to disappear. In this way the end-results can be more intelligently summarized

and the real value of the operation appreciated. To those not familiar with handling a large group of thyroid patients, these complaints may at times be alarming. It is with the hope that the experience we have gained by constant contact with post-operative thyroid cases as summarized here will be helpful to those whose experience is more limited.

PRIMARY HYPERTHYROIDISM IN CHILDREN

FRANK H. LAHEY

PRIMARY hyperthyroidism or exophthalmic goiter, while not common, is by no means unusual in children. The youngest child upon whom we have operated for primary hyperthyroidism was three years of age. The disease is in no way different in young children from its characteristic appearance in people of more advanced years. The thyroid gland shows the same moderate enlargement and the same firm consistency. Stare occurs in the same manner as in the adult and activation, excitability, nervousness, and tremor are apparent in just the same manner as in adults. Tachycardia and weight loss are similarly present in a degree proportionate to the degree of intoxication. The diagnosis of thyroidism in children is not difficult, as their young and active organisms respond notoriously and palpably to intoxication of any character.

In the beginning of our experience with primary hyperthyrodisim in children, we were a little doubtful as to the best method of handling these young individuals. Little had been written at that time concerning personal experiences with primary hyperthyroidism or exophthalmic goiter in children, and we had a considerable respect for the capacity of young children, many of whom were seriously intoxicated with thyroidism, to react postoperatively in a dangerous manner.

It has always been a conviction with us that, particularly in thyroidism, the basis of judgment and one of the most important factors in thyroid mortality, has been a background of personal experiences with the serious phases of this condition and their management.

Because of the fact that we have not as yet had a large background of experience with thyroidism in children (under ten

years, particularly), we have approached all of these cases with considerable caution. We have deferred operation in some of the cases while *x*-ray treatment has been vainly tried by excellent *x*-ray therapeutists. We have deferred operation with the hope that rest might bring about a possible spontaneous remission and result in a diminution in the intensity of the toxic symptoms, but in all of the cases coming into our hands, surgery has been necessary eventually.

The preparation of these cases has consisted of from eight to twelve days' rest in bed with Lugol's solution, drops three times a day. Food intake has been increased and a high fluid intake also maintained. The children have been permitted to be up and about for an hour or two each day in order to overcome the disadvantage to the circulatory system of complete bed rest. Preliminary drugging in proportion to the children's ages has been employed prior to the anesthesia as in adults, and ethylene has been used as the anesthetic for the operative procedure.

Because of our uncertainty as to the possible degree of postoperative reaction in these young children, practically all of the cases have been done in two stages—a right first stage subtotal hemithyroidectomy and, about six weeks later, a left second stage subtotal hemithyroidectomy. In the interval between the operations the children have been permitted to return home and be up and about, maintaining moderate amounts of activity. In most of the cases there has been a marked degree of reaction as far as rapidity of pulse-rate goes, but in none has there been any general reaction of such a serious character as to suggest any considerable danger of a fatality, in spite of the fact that several cases have been quite intensely toxic. None, however, has been in a so-called crisis.

We feel sure that some of the cases could have been done in one stage and perhaps all, but we feel equally sure that until we have had at least forty to fifty of these young children with thyroid intoxication of different degrees of intensity upon whom to operate, we are safer in approaching them through a two-stage procedure—first right and later left subtotal hemithyroidectomy. We can apply here our attitude toward all patients

with thyroidism in whom the degree of reaction is at all uncertain and so the operative risk likewise uncertain—that any doubtful risk is safer with a first-stage right subtotal hemithyroidectomy and, six weeks later, a second-stage left subtotal hemithyroidectomy, than he or she is with a complete subtotal thyroidectomy. We have always assumed the position that should a patient die following a complete subtotal thyroidectomy, it is at least possible and, we believe, quite probable that he or she would not have died following a right first-stage subtotal hemithyroidectomy. In our entire experience with thyroidectomy, now amounting to well over 7500 cases, among which were many two-stage subtotal thyroidectomies, right and left, we have but once had a patient die in the left second-stage subtotal thyroidectomy, and that patient died from causes entirely exclusive of his thyroid toxicity. As far as postoperative reaction goes (and practically all the mortality of the operative treatment of thyroidism is related to postoperative reaction), once we have gotten the patient successfully through the right first-stage subtotal hemithyroidectomy, there have been no deaths in the second-stage left subtotal thyroidectomy, regardless of how severe the original intoxication was.

Because of our satisfactory experiences with two-stage subtotal hemithyroidectomy in dangerously toxic cases of thyroidism in adults, we have, as stated above, employed it in practically all of the cases of thyroidism in children. We are quite willing to admit the likelihood that we occasionally do one unnecessary operation by this procedure, but we are ready to accept this situation in order that we may accumulate our data and personal experiences with these cases upon which judgment must be based, under conditions of the greatest possible safety to the patients

Two-stage thyroidectomy definitely lessens the operative risk in all severe cases of thyroidism, and one should always have in mind in dealing with such patients in whom the risk is uncertain, that the convenience of the patient never justifies risking his or her life for the sake of avoiding a second operation and stay in the hospital. It should be the rule, particularly

with all who have not had an extensive experience with the surgery of toxic thyroidism, that when in the least uncertain as to how the patient will react, to do a two-stage subtotal hemithyroidectomy.

There is another point in connection with subtotal thyroidectomy in children; that is the amount of thyroid tissue to leave. We believe that it is particularly necessary in young and growing children to leave a sufficient amount of thyroid tissue so that there is no question of myxedema. In those individuals who have attained their full development, the occurrence of myxedema, while undesirable, is not of such extraordinary importance, but in young children in whom the thyroid plays a not inconsiderable part in mental and physical development, it is extremely desirable that a sufficient amount of thyroid be permitted to remain to supply this need. With this point in view, then, we have made it a rule to leave slightly larger remnants of thyroid in children with thyroidism than in adults.

Conclusions.—Primary hyperthyroidism or exophthalmic goiter is not rare in children.

It occurs as typically in children as in adults.

Because of a limited experience as yet with the possibilities in the way of serious postoperative reaction, we have operated practically all of the cases in two-stage subtotal hemithyroidectomy procedures.

Myxedema is particularly undesirable in developing children, and precautions should be taken that the removal of thyroid tissue be so judged that sufficient thyroid tissue remains to prevent its occurrence.

THE CONTROL OF THE BLOOD-SUPPLY IN SUBTOTAL THYROIDECTOMY

ROBERT L. MASON

PROMINENT in the history of thyroid surgery has been the development of methods directed toward control of the abundant blood-supply. The safety of present-day operative methods is due, in a large part, to the results of this development. Methods of dealing with the blood-supply differ in various clinics. All, of necessity, have to deal with the control of the superior thyroid artery, the middle thyroid vein, and the inferior thyroid artery.

The superior thyroid artery arises from the anterior aspect of the external carotid artery close to the origin of the latter vessel, at or slightly below the level of the hyoid bone. It descends under cover of the omohyoid, sternohyoid, and sternothyroid muscles, to the apex of the upper pole of the thyroid, where it divides into the anterior and posterior branches. Medially, it is separated from the thyroid cartilage and its attached muscles by a thin layer of areolar tissue; laterally, the common carotid artery is in close proximity. With this anatomical arrangement in mind it is not difficult to ligate the artery as a trunk, and in the plan of performing subtotal thyroidectomy as developed by Dr. Lahey it forms an important step in the operation.

Adequate exposure is essential to ligate this vessel accurately. First, the skin flap should be elevated to the upper level of the thyroid cartilage. Adequate exposure of the gland is then gained by wide division of the prethyroid muscles. Then, starting close to the gland, after elevation of the upper pole by a double hook, the upper pole is divested of any remaining muscle and areolar tissue. Dissection is carried sufficiently deep that

the carotid artery and internal jugular vein may be retracted laterally. It is obvious, when this has been done, that the artery with its accompanying vein lies in the space between the thyroid cartilage and the retracted large vessels (carotid and jugular). The artery is then surrounded by a ligature carrier, beginning just lateral to the thyroid cartilage. Injury to the re-

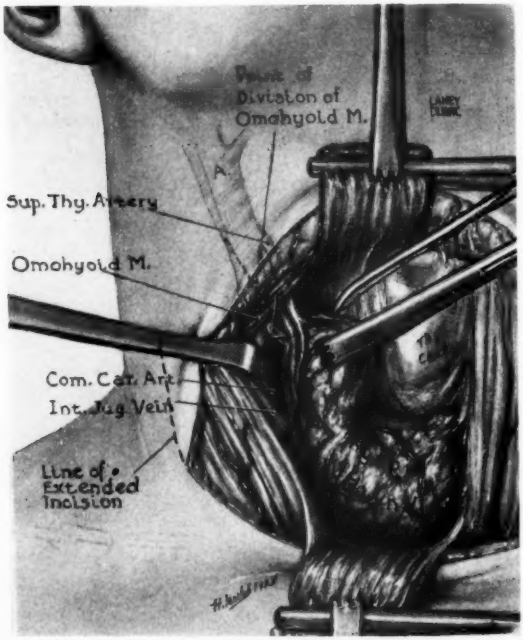


Fig. 483.—Ligation of superior pole. Dotted lines show line of incision for increasing exposure in secondary bleeding from superior thyroid artery.

current laryngeal nerve at this point cannot occur since the nerve has already entered the larynx between the arch of the cricoid and the inferior cornu of the thyroid cartilage. The ligature carrier is so constructed (Fig. 483) that the ligature (pyoktanin catgut) is held taut and can readily be pulled through by the assistant. One should make sure, before passing the ligature,

that the upper pole is exposed in its entirety in order that the ligature surrounds only the vessels, and does not include the apex of the pole. This may happen if there is a posterior prolongation of the pole upward or beneath the larynx. If such a prolongation exists, it should be gently dislocated and pulled upward and medially before the ligature is applied. If extensive, dislocation of these prolongations may be facilitated by division of the anterior branches of the artery on the anterior surface of the gland as described by Dr. Clute in this volume.

After the initial ligature, a second is applied in close proximity in order to prevent the first ligature from slipping. The upper pole is then divided below the ligature, leaving a short segment of the artery distal to the ligature. Occasionally, it is necessary to leave a thin segment of thyroid tissue distal to the ligature.

It is rare that one is called upon to control secondary bleeding from the superior thyroid artery if it has been ligated in the manner described. When it occurs, however, either before completion of the operation or after the patient returns to his bed, it is a situation calling for immediate control. In the latter instance, attention is usually called to the condition by progressive and serious difficulty in breathing. This is easily understood when one remembers that so large a vessel is actively bleeding in a small cavity, overlain by firm non-distensible muscles and containing so compressible a structure as the trachea. Swallowing is also rendered difficult by pressure upon the esophagus. The first procedure in such an emergency is to elevate the skin flap immediately and to release the suture holding the prethyroid muscles in the midline. This releases pressure sufficiently to improve breathing until the patient can be taken to the operating room. This is a better procedure than to divide the muscles transversely, since if this were done, one is faced with an actively bleeding vessel without facilities to cope with the hemorrhage. Sometimes, however, this may be necessary, and packing resorted to until the patient can be transferred to the operating room.

Control of the Bleeding Superior Thyroid Artery.—Once released from its attachment to the upper pole, the superior thyroid artery retracts upward. With release of the ligature, the surrounding tissues are quickly infiltrated with blood and one is confronted with a profuse hemorrhage which wells up into the wound, the origin of which cannot accurately be seen.

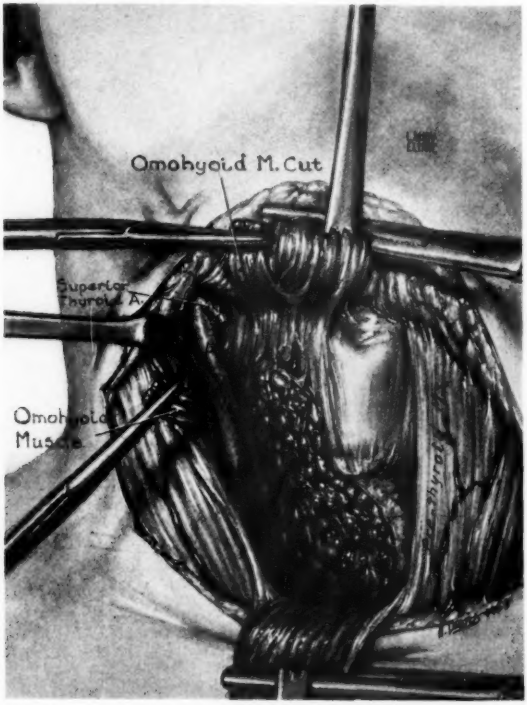


Fig. 484.—Exposure of superior thyroid artery at origin from external carotid.

To attempt control by snapping at the supposed point of origin is almost certain to result in injury to important structures, and it also wastes valuable time. In the few cases in which we have had to deal with such an emergency, we have found the following procedure to be of great value in quickly securing control of the bleeding artery.

The skin incision is extended upward in a line parallel with the sternomastoid muscle, for a distance of 2 inches (Fig. 483). The sternomastoid muscle is in this way exposed for a distance well above the level of the thyroid cartilage. It is further mobilized by dividing the fascia along its anterior border. The sutured prethyroid muscles are then redivided and retracted upward. The mobilized sternomastoid is then retracted laterally together with the common carotid artery and the internal jugular vein. The upper portion of the carotid artery, and the point of its bifurcation will then be seen to be obscured by the uppermost portion of the omohyoid muscle. This muscle is then divided and retracted. The bifurcation of the carotid is then plainly in view and the bleeding superior thyroid artery easily secured and its point of origin from the external carotid artery (Fig. 484).

The Middle Thyroid Vein.—While the thyroid gland is profusely supplied by veins, that with which the surgeon has most to deal, is a large vein into which most of the veins on the anterior surface of the thyroid appear to enter, and which makes its way to the internal jugular vein, entering this structure somewhere between the level of the upper and lower third of the thyroid. It would seem that "lateral thyroid vein" would better describe it than the term "middle thyroid vein" of the anatomy texts. If not adequately secured and divided, this vessel is very apt to be torn during mobilization of the gland, often at its junction with the internal jugular, resulting in profuse venous hemorrhage. In addition, by its division, the thyroid lobe may be more readily retracted medialward thoroughly exposing the lateral surface of the gland. The surgeon may then see accurately how much gland is to be left behind. Also the inferior parathyroid gland often lies behind the middle thyroid vein and by its division this important gland may be seen and carefully preserved.

The middle thyroid vein is secured and divided by first retracting the lower pole gently toward the midline. The vein is then sought in the areolar tissue that lies between the gland and the great vessels, carefully dissected free and divided between

hemostats (Fig. 485). The division should be well toward the entrance to the jugular since if it is divided at a higher level, an underlying parathyroid might be injured. It is well to ligate the divided ends at this stage rather than later on in the resection with a risk of the hemostat being torn away. It is not infrequent, of course, to find several veins running from the lateral surface of the gland to the internal jugular, and when this is the case, each must be dealt with in the manner described.

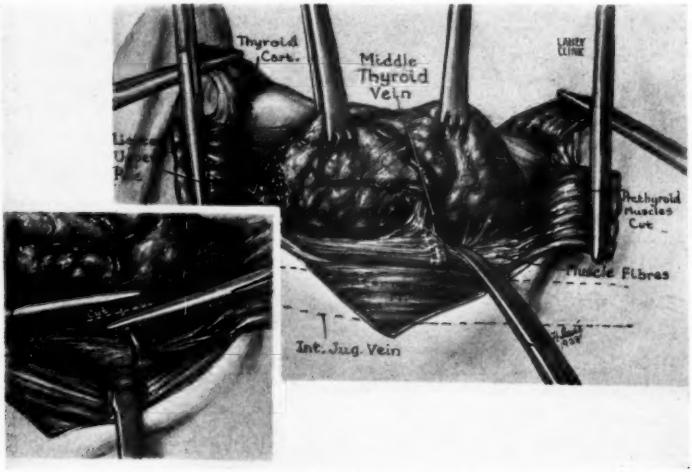


Fig. 485.—Dissection and division of middle thyroid vein.

The only other large vein encountered is the inferior thyroid vein, extending downward from the isthmus. This large vein is always well exposed in the field and can be dealt with during resection of the isthmus. It rarely requires separate ligation.

The Inferior Thyroid Artery.—The superior thyroid artery described above, and the inferior thyroid artery, on each side, furnish the thyroid gland with the profuse arterial supply which the gland requires. The superior thyroid artery descends as a single artery to the upper pole where it divides into anterior and posterior branches. Accordingly, it is best ligated as a single trunk. The inferior thyroid artery, on

the other hand, while carrying an equal if not greater supply of blood, divides into from two to four branches just before entering the gland. These branches, distributed through the gland tissue, can usually be secured adequately in the course of the resection by hemostats applied to the gland tissue. The inferior thyroid artery furnishes the blood-supply of the parathyroids, and if at all possible, we prefer not to ligate the artery as a trunk. It not infrequently occurs, however, that one of these branches is not adequately secured, with resulting hemorrhage. To attempt to secure the bleeding point by snapping in the thin remnant of thyroid tissue jeopardizes the recurrent laryngeal nerve which lies beneath. Rather than do this, in such instances, we choose to ligate the inferior thyroid artery as a trunk.

In ligating the inferior thyroid artery, one must keep in mind its course, and its relations to the recurrent laryngeal nerve. As commonly visualized, and as described in a number of anatomy texts, the artery ascends from its origin from the thyrocervical trunk, directly to or near the lower pole of the thyroid where it gives off its branches to the gland. As a matter of fact, however, the artery rarely, if ever, takes this direct course. Rather, from its origin as one of the terminal branches of the thyrocervical trunk it ascends beneath the common carotid artery well up to the level of the mid-portion of the thyroid cartilage, often to the upper level of this structure, and then curves upon itself, descends toward the lower pole of the thyroid, and divides into two or more branches. Just beyond the point of branching and in relation to the branches lies the recurrent laryngeal nerve. Berlin and Lahey in a series of dissections found that the nerve tends more commonly to be anterior to the artery and its branches on the right side than on the left.

In ligating the artery, the thyroid remnant is retracted medially, and the great vessels of the neck, laterally. The areolar tissue which binds the common carotid artery is then entered, and the artery further mobilized laterally. This done, the inferior thyroid artery comes plainly into view. It in turn is freed from the areolar tissue which surrounds it (Fig. 486).

A small ligature carrier is then passed around the vessel at or proximal to the curve described above. By ligating it at this point, well away from the gland, and by first clearly exposing the artery, there is little danger of injury to the recurrent laryngeal nerve. We have hesitated to perform bilateral ligation of the inferior thyroid because of the danger to the blood-supply to the parathyroids. We have found it necessary in a very few

Fig. 486.—Dissection and ligature of inferior thyroid artery.

cases, however, and in these cases no apparent harm to the parathyroid glands resulted.

Two other procedures have been of value in dealing with small but persistent bleeding points which prevent dry closure. One is the folding over of the thyroid remnant to the pretracheal fascia as shown in Fig. 487. Care is taken to suture only the outermost edge of the remnant and never to carry the suture

through the main body of the remnant. To do this is almost certain to injure the recurrent laryngeal nerve. By folding the remant over in the manner illustrated, all persistent small bleeding points from the cut surface of the gland are controlled. Occasionally, there is a small area on the outer surface of the rem-

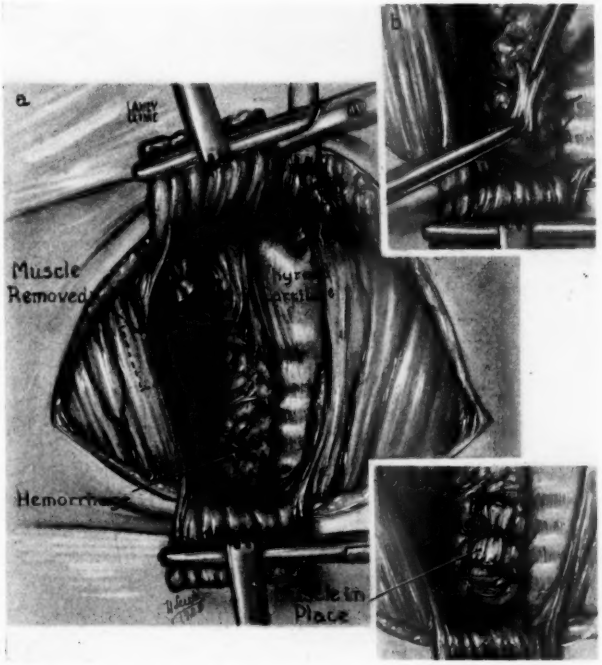


Fig. 487.—Suture of thyroid remnant to pretracheal fascia. Application of muscle to persistently bleeding point.

nant which persists in bleeding. In such an instance we have found the application of a small piece of muscle to be of value. The muscle which can be taken from the adjacent sternomastoid is sutured in place over the bleeding area as shown in Fig. 487.

THE INTRACARDIAC INJECTION OF EPINEPHRINE IN CARDIAC SYNCOPE

RICHARD B. CATTELL

INTRACARDIAC injections of epinephrine have been done in collapse due to many causes. A cursory review of the cases reported in the literature has failed to show very encouraging results. In addition, it is probable that the actual results are even less favorable than one could get from the reported cases, since failures of this type are rarely reported. That this measure is rarely of benefit is probably due to its employment in hopeless cases, particularly in patients with heart disease, pulmonary embolus and long-standing debilitating diseases. On the other hand, in surgical emergencies, the indications are clear and the results should be more satisfactory. Dr. Sise has used epinephrine subcutaneously, intramuscularly, and intravenously in the treatment of vascular depression incident to spinal anesthesia. He is reporting this elsewhere in this volume.[1] In order to be prepared for the treatment of vascular depression we have felt it necessary to have sterile syringes and needles in each operating room for these emergencies. A suitable cardiac needle is kept in this equipment. Pearse[2] has recently called attention to the intravenous use of epinephrine in vasomotor collapse. Its employment at the first stages of collapse will make the necessity of intracardiac injection less frequent.

I should like to report the following case where the intracardiac injection of epinephrine in cardiac syncope resulted in a complete recovery.

Case Report.—Mrs. A. E. F., 9215, aged sixty, was admitted to the New England Deaconess Hospital March 2, 1929, on the

[1] Page 1369.

[2] Jour. Amer. Med. Assoc., 92, 1263, 1929.

service of Dr. E. P. Joslin (Case No. 7763) with diabetes mellitus and a carbuncle of her back. Since January 1925, she had complained of loss of strength, polyuria, polydipsia, and polyphagia. There was a gradual loss of weight. A skin eruption appeared over her back and shoulders several months before admission. Two months previously a carbuncle appeared on her back, and her physician found sugar in her urine at this time. During this short period she became very nervous and she noticed palpitation, dyspnea, and an increase in severity of the previous symptoms. She lost 18 pounds in two months.

Physical examination showed an elderly woman who appeared very nervous. She was quite deaf. The thyroid was asymmetrically enlarged, nodular, and was larger on the right side in which a discrete adenoma could be felt. The pulse-rate was 120 and regular; the blood-pressure ranged from 160/80 to 190/100 mm. of Hg. There was a small umbilical hernia present. A pigmented and scarred area was seen over the skin of the back. On the upper back was a sloughing carbuncle.

The carbuncle was incised and treated by Dr. L. S. McKittrick. She was seen by Dr. Lahey who found that she had an adenomatous goiter with secondary hyperthyroidism.

The admission specimen of urine showed diacetic acid and 4.2 per cent. sugar. The blood-sugar was 0.20 gm. After a preliminary test diet, she was given a diet consisting of 112 carbohydrate, 60 protein, 112 fat (1696 calories) with 25 units of insulin daily and the urine became practically sugar free. The basal metabolic rate was +21. *x*-Ray of the chest showed moderate enlargement of the heart. Twenty-four days after incision of the carbuncle, operation on the thyroid was carried out.

Diagnosis.—Diabetes mellitus, carbuncle of back, adenomatous goiter with hyperthyroidism, arteriosclerosis with hypertension.

At operation, under ethylene anesthesia, the prethyroid muscles were divided and retracted. An adenomatous gland about three times normal size was exposed that was larger on the right side. A subtotal thyroidectomy was done, leaving fairly large gland fragments on each side, which were folded over to the

median line. The prethyroid muscles were sutured with mattress sutures. While a continuous suture was being placed in the midline of the muscles, there were two short sounds of air intake in the anterior jugular vein at the lower angle of the incision. This corresponded to the interval of two heart-beats. The vein was secured and ligated. About two minutes later the anesthetist reported a cessation of breathing and that no pulse nor blood-pressure could be obtained. Artificial respiration was begun at once with oxygen and carbon dioxid and maintained by pressure on the bag of the closed gas apparatus. No cardiac impulse could be felt. An emergency sterile syringe and needle and some 1 : 1000 epinephrine solution were obtained at once. A long, fine needle was introduced through the fourth left interspace, and was felt to encounter the cardiac muscle. There was no movement of the needle although dark blood was withdrawn. About 2 minims of adrenalin were injected and the needle and syringe showed a rhythmic movement and then stopped. Three to 5 minims were then introduced and this caused rapid and violent movement of the needle and syringe. The needle was withdrawn at once and a temporal pulse could be obtained immediately afterward. It was estimated that the syncope lasted between one and two minutes. Her systolic blood-pressure soon rose to 200 mm. of Hg., and the pulse-rate became very rapid but regular. There was no evidence of auricular fibrillation. In spite of pure oxygen she remained slightly cyanotic and did not arouse. The neck wound was closed in the usual manner; respiration became voluntary and normal. She was still unconscious when returned to her bed. A blood-sugar was taken at once and 500 c.c. of a 10 per cent. glucose solution were given intravenously. Twenty minutes after her return to her room the pulse-rate was 152 and regular. Her color was good. She regained consciousness in thirty minutes. That evening her condition was satisfactory. Her convalescence was uneventful and she was discharged from the hospital fifteen days after thyroidectomy. The diabetes was well controlled at this time.

The intracardiac injection of epinephrine undoubtedly was the means of saving this patient's life. Under such circum-

stances as these, where syncope occurs during an operation, if the contractions of the heart can be started, conditions are favorable for continuance of the heart-beat. It was felt that this might be an instance of hypoglycemic shock incident to the anesthesia or insulin, but the blood-sugar taken immediately after operation, before the administration of glucose was 0.22 gm. The glucose was given intravenously because of possible shock or hypoglycemia. Ventricular fibrillation, if present, would probably have caused some movement of the needle. A change in rate such as occurs in heart-block (Stokes-Adams syndrome) could possibly account for cessation of the heart-beat. It would seem that the small amount of air taken into an opening in the rather small anterior jugular vein would be insufficient to cause air embolism, but this explanation of the syncope must be considered as the probable cause.

THE LIGATION OF RETROLARYNGEAL SUPERIOR THYROID POLES

HOWARD M. CLUTE

THE ligation of the superior thyroid artery as a preliminary procedure to the immediate removal of one lobe of the thyroid gland is a most important step. Failure to secure this vessel adequately may result in a serious hemorrhage due to its slipping from the ligature and its ascent up the neck. When hemorrhage does occur from the superior thyroid artery its control is frequently a matter of considerable technical difficulty. The control of such a hemorrhage is reported in this volume by Dr. Mason. Anything, therefore, which can be done to make more certain the adequate ligation of the superior thyroid artery is well worth consideration.

The superior thyroid artery goes to the lateral surface of the thyroid cartilage and then enters the superior pole of the thyroid gland from the mesial surface. In a great many cases of goiter the thyroid gland extends up the neck for varying distances beyond the point at which the thyroid vessels enter the gland. Many times this extension of the superior thyroid pole goes posteriorly for a distance of an inch or two behind the larynx. This fact becomes of marked importance when we are attempting to ligate the artery, since the retrolaryngeal portion of the gland may be very difficult to deliver and often is held down by the vessel.

Attempts to secure the thyroid artery at or near the point where it enters the gland, when there is a retrolaryngeal extension of the superior pole, will always be unsuccessful because of the large retrolaryngeal portion of thyroid tissue which is present. Furthermore, attempts to dislodge this retrolaryngeal portion of the thyroid gland by traction and by manipulation are

dangerous because they may tear the branches of the superior thyroid artery and produce a serious hemorrhage. We have developed, therefore, a small point in technic for dealing with these retrolaryngeal and retropharyngeal superior thyroid poles which we have found to be of great value. When the superior pole of the thyroid gland is exposed there will be seen lying on its anterior and mesial surface the anterior division of the superior thyroid artery and, accompanying it, one or more

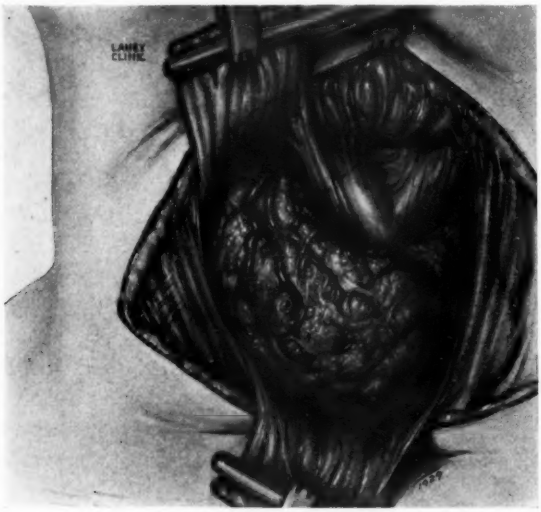


Fig. 488.—Drawing of the right superior pole of a hyperplastic thyroid gland as it presents itself at operation. Note that the anterior division of the superior thyroid artery is lying on the anterior and mesial surface of the lobe. The dotted line indicates the extension of the hyperplastic superior pole posteriorly behind the larynx.

large veins. Clamps are applied to this artery and its veins in the methods shown in Fig. 489, two clamps (Fig. 489, 2, 3) being put on the proximal part of the artery and one clamp (Fig. 489, 1) on the distal portion to prevent back bleeding when the vessel is cut. As the artery is tied the proximal clamp (Fig. 489, 3) is removed, but the distal one (Fig. 489, 2) is left in place until a econd knot is placed on the vessel.

As soon as the main vessels coming from the laryngeal surface of the gland and running down on to the anterior surface of the pole are cut, it is possible with the finger inserted behind the retrolaryngeal portion of the pole, to push it forward. Many times a few small veins will be encountered on the surface, and these can be made tense as pressure is applied upon the pole from behind. When they are tense they are caught with forceps

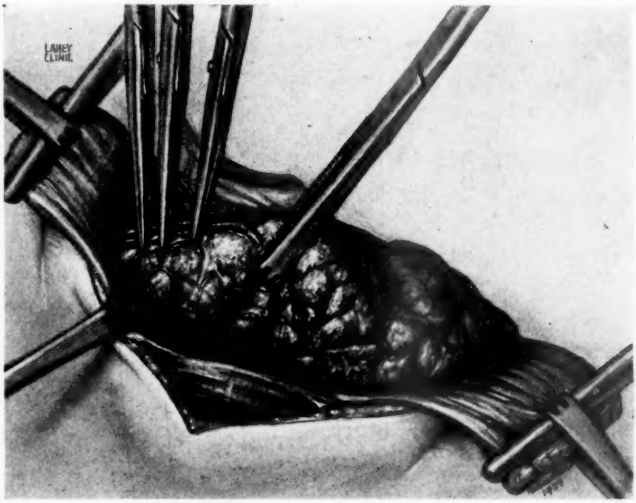


Fig. 489.—Before any attempt is made to dislodge the posterior extension of the superior pole the anterior devision of the superior thyroid artery and its accompanying vein is caught and cut. This frees the chief tissue which binds the superior pole and makes its delivery impossible.

and cut. The pole now comes down readily from its posterior position and is easily delivered into the wound, as can be seen in the accompanying illustrations (Figs. 490, 491). Occasionally a few vessels will be found coming into the thyroid gland at this superior portion from a lateral direction. As these come into view they are caught with snaps, and cut. By this maneuver, then, the process of delivering a large retrolaryngeal pole is made relatively simple, and the chief danger which has previously

consisted of the possibility of hemorrhage from the tearing of the superior thyroid artery is avoided.

One of the chief places for the occurrence of hyperplastic tissue in cases of exophthalmic goiter recurring after operation is at the superior pole, and it is our belief that this is usually due to failure to remove all of the retrolaryngeal portion of the superior pole at the original operation. If the anterior thyroid

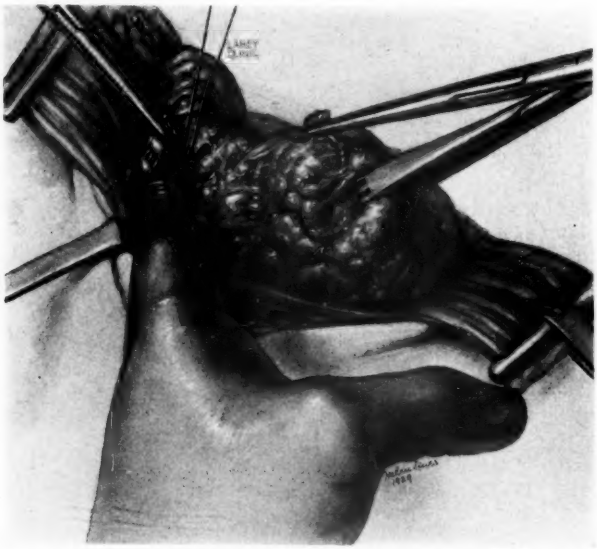


Fig. 490.—The retrolaryngeal portion of the superior pole is now readily delivered after the anterior branches of the superior thyroid artery are divided. A ligature surrounds some small veins which still are holding the pole from complete delivery.

vessels are ligated and cut, the retrolaryngeal portion of the pole can be safely and readily dislodged from its position, and brought into a view where one can be certain that all of the superior pole is secured.

Inasmuch as all of this procedure is done high in the neck, above the level of the inferior horn of the thyroid cartilage, no fear need be had that the recurrent laryngeal nerve will be caught

during this dissection. As soon as the retrolaryngeal portion of

Fig. 491.—The superior thyroid vessels are completely ligated. The entire pole is now displaced and it can be readily seen first, that the blood-supply is completely controlled and second that no hyperplastic thyroid tissue is left behind at the superior pole to cause a recurrence of the hyperthyroidism

the pole is brought down, clamps are then applied to the lateral surface, and the thyroidectomy is performed.

CERVICAL FAT FOLDS SIMULATING GOITER

HOWARD M. CLUTE

NOT infrequently patients are sent to the clinic for examination for suspected thyroid disease who present no symptoms of thyroid trouble but who show what appears to be at first glance an enlargement of the thyroid gland. The resemblance to goiter of a transverse fold of fat in the neck just above the clavicle and the sternal notch is very great. Many physicians mistake this fold of fat for a thyroid enlargement and many patients as well very frequently suspect it of being a goiter (Figs. 492, 493).

Fig. 492.

Careful examination of the neck in these patients reveals the true nature of the enlargement in most cases. At times, however, it is difficult to be certain that the thyroid gland is not

Fig. 493.

Fig. 494.

enlarged and that the prominence in the front of the neck is entirely in the subcutaneous tissue. All of these patients should be carefully examined by some suitable method such as the one Dr. Lahey has described in which the larynx is displaced to one side and each lobe of the thyroid gland palpated between the thumb and finger. By this procedure one can feel the normal thyroid gland beneath the fat of the neck. After this procedure has been finished, however, it is advisable to attempt to pick up the fold of fat in the front of the neck as is shown in Figure 494. It will then be noticed that the enlargement in the neck is obviously fatty tissue in the subcutaneous layer and is not related to the thyroid gland. The first and second illustrations show the patient's neck and the general simulation of the fold of fat to an enlargement of the thyroid gland of the diffuse colloid type.

The third illustration demonstrates that this enlargement is in the skin and fat, and can be displaced from the deep structures of the neck by the examining fingers.

LINGUAL THYROID GLAND: REPORT OF A CASE AND A DISCUSSION OF ABERRANT THYROID TISSUE

RICHARD B. CATTELL AND WALTER B. HOOVER

THE thyroid gland has its origin at the base of the tongue and reaches its normal position over the upper trachea and thyroid cartilage quite constantly. However, in rare instances, the entire gland may rest permanently in any position from the base of the tongue to its usual position; it may even descend intrathoracically. The whole or part of the gland may be found at the base of the tongue as a lingual thyroid gland. This is the least frequent of all aberrant locations.

There has been one patient with a lingual thyroid gland reported from this clinic by Dr. Lahey in 1923,[1] and we have observed a second one this year, who died from intercurrent disease, on whom an autopsy was performed. Lingual thyroid glands are so rare that all should be reported. These two instances of lingual thyroid gland have been observed out of a total of 7600 operations on the thyroid, an incidence of 1 : 3800, which demonstrates its infrequency in our experience.

Aberrant thyroid tissue in other positions is somewhat more frequently seen. Leech, Smith, and Clute[2] reported from this clinic 4 cases of aberrant goiter in a position lateral to the thyroid. In each case the main thyroid body was found in the usual position without any demonstrable connection. The structure of these lateral thyroid bodies was fairly constant; each showed the structure of a papillary cyst-adenoma, which they recognized as the lowest grade of thyroid malignancy. These extend commonly into the deep cervical chain of lymph-glands and may be found from the clavicle to the mastoid process. Radical excision can be carried out.

[1] Surg., Gynec. and Obst., 36, 395, 1923.
[2] Amer. Jour. Path., 4, 481, 1928.

Lateral aberrant thyroid tissue has been shown by Norris[1] to develop from the posterior portions of the third and fourth branchial pouches in contrast to the thyroid gland which comes from the median portion of the floor of the pharynx. He has demonstrated the fusion of these lateral bodies with the main body of the gland in the 15 mm. human embryo. Following this these lateral bodies atrophy and take no part normally in the formation of the adult gland. The cessation of this process in any stage accounts for thyroid tissue in the lateral position. We have seen three additional patients with lateral aberrant thyroid tissue since the previous report, making seven in 7600 goiter operations, an incidence of approximately one in a thousand.

When portions of thyroid are found in an intrathoracic position they have generally descended during adult life, although in rare instances the entire thyroid may descend lower than usual and occupy this position. It is of interest that many dogs show portions of thyroid tissue within the pericardial sac. While it is recognized that small portions of thyroid tissue may be found in ovarian tumors and other positions far distant from the neck, these are of no clinical importance.

The most frequent congenital anomalies associated with the development of the thyroid are thyroglossal cysts, sinuses, and fistulae. These occur once in each 120 goiter patients seen by us. They will be reported shortly.

We wish to report a case of a complete lingual thyroid gland, and in addition, to give the subsequent history of the one previously reported.

Case Report.—Mrs. M. H., 7088, came to the clinic in November, 1928, complaining of a growth in her throat and skin nodules. She was a white woman of sixty-two years, who had always been in good health. There was no familial history of goiter. She had been married forty-four years and had had ten pregnancies. A wen of the scalp had been present many years.

She stated that she had been aware of a growth in her throat for forty years but there had been little change in its size. There

[1] Amer. Jour. Anat., 20, 411, 1926.

had been no respiratory difficulty at any time. She had had difficulty in swallowing solid food. One month before entry, lumps were noticed in the skin of her back. Since that time they had appeared over all the skin. There was no digestive disturbance and she was unaware of any loss of weight. Her appetite was good. She had had a sensation of cold for many years.

Three weeks before entry she contracted a "bad cold" which has persisted. Her voice has become hoarse and her eyes inflamed. She has noticed increasing nasal obstruction, vertigo, deafness, and tinnitus. Her vision has been failing.

Fig. 495.—Drawing of the complete lingual thyroid gland reported. It fills the oral pharynx.

Physical examination showed an elderly woman who was having a mild respiratory obstruction. Her hair was thin and gray. There was a tumor the size of an egg over the left parietal region and a raised, soft lesion over the left temple. The entire face was puffy and mottled in appearance. Both lids were swollen and there was a marked conjunctivitis and chemosis. The vision was impaired. There was a partial nasal obstruction with redness of the mucous membrane and drainage of pus from the left middle meatus. The teeth were false.

There was a tumor at the base of the tongue, in the midline, the size of a walnut. It was smooth and regular in outline, and covered with normal mucous membrane. Large veins were seen over its surface. It rose in the nasopharynx on swallowing and at rest almost completely filled the oral pharynx (Fig. 495). The epiglottis was displaced backward, making it difficult to

Fig. 496.—Leukemia cutis. Lesions on the back showing the pigmentation of the skin nodules giving a mottled appearance. There is an iodin stain over the right shoulder where a nodule was excised.

see the larynx, but the action of the arytenoids and cords was normal. There were numerous firm cervical glands on both sides. The thyroid could not be palpated in its usual position.

The rest of the examination was essentially negative except for the skin. It was excessively dry, rough, and scaling. There was a mottled appearance to the face and chest wall due to the brownish pigmentation of some of the cutaneous nodules. The

latter were very numerous and were raised, smooth, rounded with central pigmentation. They were most noticeable over the shoulder girdle and back (Fig. 496). The largest measured 3 × 5 cm. The hands had the typical "spade" appearance.

Examination of the urine was negative with no melanin present. Plates of the skull, chest wall, and pelvic bones showed no evidence of metastases. The chest plate showed only slight enlargement of the heart to the left, but no mediastinal widening. No metabolic determination could be done on account of the respiratory obstruction.

She was admitted to the New England Deaconess Hospital and a pigmented cutaneous nodule was excised which was reported by Dr. Shields Warren to be non-pigmented melanotic sarcoma. The diagnosis was lingual thyroid gland, melanotic sarcoma, and myxedema.

Following this, she complained of increasing respiratory obstruction, severe headaches, and fever. One month later nasal obstruction became complete, her eyes became more prominent, and she was mentally confused. At this time she was admitted to the Palmer Memorial Hospital. During the third and fourth months she was given gr. xxx of potassium iodid daily in order to determine the ability of the lingual thyroid gland to store iodin. This was followed by marked shrinkage in the size of the cutaneous nodules and many disappeared. At the same time there was improvement in breathing and swallowing and her eyes were less prominent.

Examination of the blood showed a marked secondary anemia. The hemoglobin was 30 per cent., red blood-count 1,060,000, and the white blood-count was 6700 and 3300. The smear showed only rare leukocytes with many large lymphocytes, with immature cells present. The blood-sugar, non-protein nitrogen, and chlorid were normal. She died five months after the first examination.

At the postmortem examination by Drs. Warren and Lewis, it was felt that death resulted from a melanotic sarcoma with wide-spread metastases. Microscopical examination, however, showed it was lymphatic leukemia in the aleukemic phase with

involvement of the skin (leukemia cutis), trachea, lymph-nodes, lung, spleen, pancreas, adrenal, and kidney.

Examination of the lingual thyroid gland showed it to be attached by a broad base at the back of the tongue, and covered by a thickened mucous membrane. A few fragments of tissue were removed from the normal position of the thyroid, but no gland tissue demonstrated. Examination of the lingual thyroid showed a fairly normal structure (Fig. 497). There was an abundance of connective-tissue forming islands of follicles. Beneath the mucous membrane was a collection of undifferentiated lymphoid cells (leukemia) (Fig. 498).

The case reported by Dr. Lahey was operated upon on September 2, 1921. The following table shows the basal metabolic determinations:

September 1, 1921 (Preoperative)	+ 2
September 14, 1921 (Postoperative)	− 18
November 17, 1921 (After thyroid extract)	+ 19
July 11, 1922 (Thyroid extract discontinued)	− 15
April 24, 1923 (After thyroid extract)	+ 20
March 5, 1925 (Thyroid extract—2 months pregnant)	+ 16

It will be seen that myxedema resulted from excision of the lingual thyroid gland in the first case but was controlled by thyroid extract. In the second, myxedema had probably been present for many years due to an inadequate amount of thyroid tissue (Fig. 499). Some degree of thyroid deficiency seems likely in any instance of a lingual thyroid gland since there is only a small space for possible development in the oral pharynx. There was little evidence of any obstruction caused by the swelling in the second case and removal was not considered. Removal is quite feasible since there is no danger of injury to the parathyroids, as pointed out in the previous report.

Summary.—The origin and frequency of thyroid tissue in

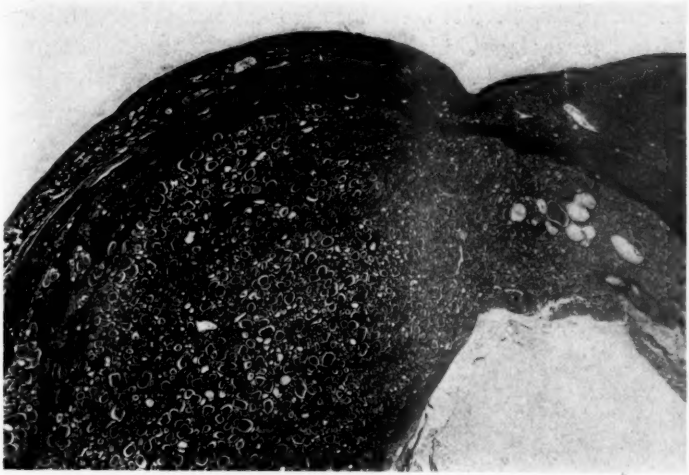


Fig. 497.—Low power photomicrograph (Dr. Shields Warren) showing an essentially normal thyroid structure. There is an abundance of colloid present which has been increased by iodin feeding.

Fig. 498.—Higher power photomicrograph showing undifferentiated lymphoid cells below the stratified epithelium. The follicles are distended with colloid. Compare this picture with that seen in Fig. 499.

aberrant positions has been discussed. A patient with a complete lingual thyroid gland is presented. Death resulted from lymphatic leukemia in the aleukemic phase. It was interesting

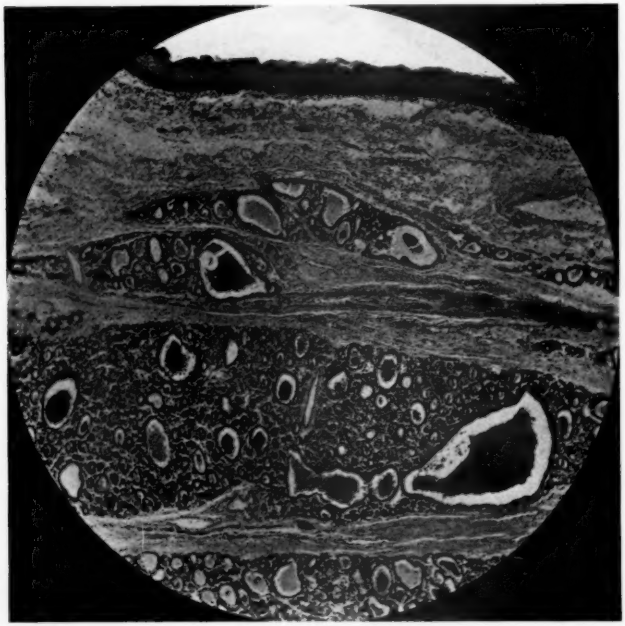


Fig. 499.—Photomicrograph of the lingual thyroid removed by Dr. Lahey in 1921. Note the hyperplastic structure and lack of lymphoid cells above the follicles. (Reprinted from Surg., Gynec., and Obst., March, 1923, p. 307.)

to find shrinkage of the skin nodules and improvement of the respiratory and esophageal obstruction following the administration of iodids.

A REPORT OF TWO CASES OF PERNICIOUS ANEMIA AND EXOPHTHALMIC GOITER

LEWIS M. HURXTHAL

WE have observed 2 cases of pernicious anemia who had previously been operated upon for exophthalmic goiter. They are of interest because of observations of the basal metabolism at various stages and the response in one to Lugol's solution and removal of thyroid remnants for recurrent hyperthyroidism and the effect in the second of raw liver ingestion.

Case I (No. 1821).—An unmarried woman of fifty-two (Scottish descent) came to the clinic in October, 1927. In 1907 the patient had been operated upon for exophthalmic goiter, a hemithyroidectomy having been done. Following operation the patient made an excellent recovery with the usual weight gain and disappearance of symptoms. The exophthalmos had improved, but was still present. Eight years before (1919) a hysterectomy was performed for a fibroid uterus. Two years before (1925) the patient had first noticed tingling of her fingers, weakness of the legs, and at times soreness of the tongue. Later some difficulty in walking had been experienced. A few months before coming under our observation, the patient had been studied elsewhere. A diagnosis of primary anemia was made and liver was given. The anemia was not severe (3,200,000), but difficulty in walking was the outstanding symptom. The blood-picture was reported as showing a high color index, large well-filled red cells, a relative lymphocytosis. The basal metabolism rate was slightly below normal at that time.

One month before coming to the clinic she began to lose weight, noticed palpitation, nervousness, and an increased sensa-

tion of warmth. Her pulse was thought to be more rapid than previously.

Examination revealed a woman of good color. The hair was white. Moderate exophthalmos was present. The tongue was smooth. There was an easily palpable hyperplastic left lobe of thyroid present. The heart, lungs, and abdomen were negative. The knee-jerks were absent. The heel-to-knee test revealed moderate ataxia. The Romberg test showed considerable swaying. The pupils were equal and reacted to light and distance. The blood-pressure was 190/90, the pulse 120. The skin was warm and moist.

The basal metabolic rate was +31. The blood Wassermann was negative, the red count 5,040,000, hemoglobin (Sahli) 102 per cent. The blood-smear showed no definite abnormalities. There were no free HCl in gastric contents after the test meal.

Three determinations of the basal metabolic rate were made before Lugol's solution was given. After it was begun, there was a drop in pulse and basal metabolism (Fig. 500) and slight improvement in symptoms. A subtotal hemithyroidectomy was performed without incident. The patient was discharged with instructions to take $\frac{1}{2}$ pound of raw liver daily. The patient returned in one month much improved. She could walk better, sleep better, felt less warm, and much stronger. The red count at this time was 5,600,000.

The patient stated she had been taking liver only three times a week, so she was, therefore, advised to continue with the same amount. In February she returned complaining of feeling cold and still had some difficulty in walking. She was very constipated, and was referred to Dr. Jordan, who eventually straightened this out with diet. The red count at this time was 4,450,000, hemoglobin 80 per cent. Liver extract was then prescribed. Since then she has been making very slow progress. The ataxia is still present, but improved. The knee-jerks are hyperactive. She continues to take $\frac{1}{2}$ pound of liver daily or the equivalent in liver extract. The red count has not fallen below 4,260,000, having been determined about every two months.

Discussion of Case I.—This case brought up the question of whether or not the high basal metabolic rate was due in part or wholly to pernicious anemia. After a control period, Lugol's solution was given. The drop in pulse- and metabolic-rate following this was quite definite. In view of a normal rate three months before and the development of thyrotoxic symptoms one month before, we concluded that this was a recurrence of thyroid toxicity in a patient with pernicious anemia. At operation a large hyperplastic left lobe of the thyroid was found and mostly removed. Subsequent observations confirmed the original opinion (Fig. 500).

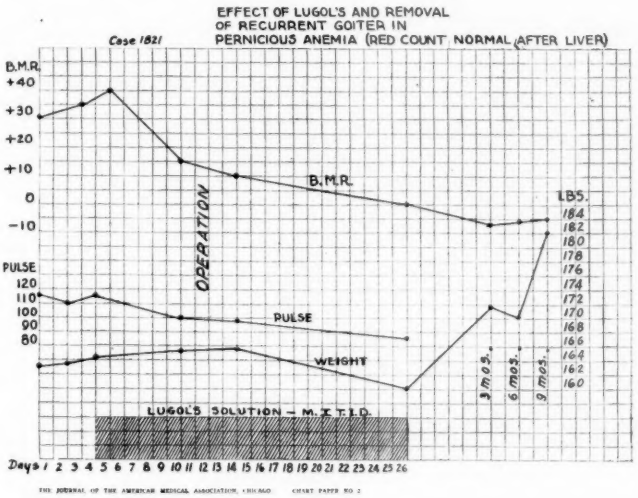


Fig. 500.

Case II (No. 6636).—An unmarried woman of thirty-nine (English descent) came to the clinic in September, 1924. Her chief complaint was palpitation, dyspnea, and loss of weight, extending back over a period of several months. The past history was unimportant. Her mother had a small goiter.

The examination showed a nervous woman of excellent color (especially noted). There was no exophthalmos, but

fixation was present as well as Möbius' and von Graefe's signs. The thyroid was enlarged and hyperplastic. A fine tremor of the hands was present. The blood-pressure was 160/80; the pulse, 120.

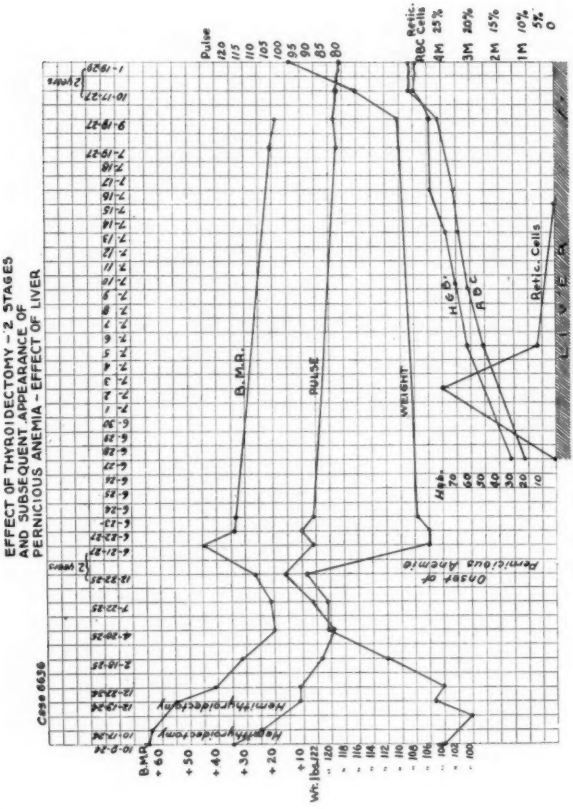


Fig. 501.

The operation was done in two stages at six weeks' interval. Following operation (Fig. 501), the patient gained in weight, but the basal metabolic rate did not fall to normal. She was seen from time to time. No thyroid remnants were ever palpable. She complained of nervousness and palpitation from

time to time. Lugol's was given off and on with no effect. She looked well when seen in November, 1926, at which time she lost her father and was greatly worried over the mental illness of her mother. In June, 1927, when next seen, she complained of nervousness and a prickly sensation in the fingers. She was also losing weight. Her appetite was poor, the pulse-rate was 120 in the clinic. She appeared pale and nervous. The hair was brown, the tongue smooth.

After having been sent to the hospital a diagnosis of pernicious anemia was made. The blood-smear showed well-marked variation in size and shape. The differential count was polymorphonuclears 48 per cent., lymphocytes 45 per cent., large mononuclears 5 per cent., eosinophils 2 per cent. Platelets appeared reduced and the reticulated cells were 0.5 per cent. The red count was 1,200,000, the white blood-cells 4500, the hemoglobin 30 per cent., bilirubin 0.6 mg. There was no free HCl in the gastric contents. Ground raw liver, 1 pound daily, was administered in orange and lemon juice.

The patient made an excellent recovery with marked improvement in appetite, weight, and general well-being. The patient consumes three whole raw calves' livers a week in preference to cooked liver or liver extract. The red counts taken at more frequent intervals than shown on charts have remained around 5,000,000. The bilirubin fell to 0.2 mg. when taken one month after treatment.

Discussion of Case II.—This patient showed the elevation of basal metabolic rate which is at times present when the red count and hemoglobin are low in pernicious anemia. While the basal metabolic rate did not fall below +20 after the blood had returned to normal, previous observations before the apparent onset of the anemia showed that her normal rate was probably about the same figure (+20). The loss of weight coincident with the development of the anemia suggests either a diminished food intake or a manifestation of the disease. The effect of raw liver was striking and removes all doubt as to the diagnosis.

Summary.—1. Administration of Lugol's solution to a pa-

tient with recurrent hyperthyroidism and pernicious anemia (without anemia) was followed by a drop in pulse- and metabolic-rate after a suitable control period. This result remained permanent after operation.

2. Administration of raw liver to a patient with pernicious anemia (with anemia) who had been operated upon for exophthalmic goiter and who had been suspected of recurrent hyperthyroidism resulted in a drop in the basal metabolic rate, pulse, and a gain in weight coincident with the disappearance of anemia.

VASCULAR DEPRESSION OF SPINAL ANESTHESIA

LINCOLN F. SISE

VASCULAR depression is the most serious condition which accompanies spinal anesthesia, and is the cause of most of its mortality. This anesthesia is extremely valuable, as it is in many ways and for many operations the best anesthesia which we have. Yet its mortality has cast a shadow on it and has deterred many men from using it.

The mortality of spinal anesthesia varies from about 1 in 100 under unfavorable conditions,[1] probably to about 1 in 10,000 under most favorable conditions, with a general average of about 1 in 3000 where conditions are reasonably good.[2] As this mortality is due mainly to vascular depression, the importance of this in spinal anesthesia is readily appreciated.

Vascular depression manifests itself chiefly by a fall in blood-pressure, and is due mainly to vasomotor paralysis. Spinal anesthesia is a spinal nerve-root block. In these roots run the vasomotor fibers, going to the sympathetic system via the communicating branches. When the nerve-roots are blocked, the vasomotor fibers in them are also blocked, and a vasomotor paralysis of the affected area results.

A second cause for the vascular depression is respiratory depression. This is practically always present in spinal anesthesia. Novocain itself is depressing to respiration, as are probably most of the other local anesthic drugs used in spinal anesthesia. The intense and wide-spread muscular relaxation which is present during the anesthesia lowers the metabolic processes and the use of oxygen and thus the need of respiratory effort. In a high anesthesia more or less paralysis of the intercostal muscles is frequently present. Often depressing drugs have been given before operation to dull the patient's mind.

The combined result of all these factors is well-marked depression of respiration.

Respiratory depression probably causes vascular depression through lack of the normal sucking and pumping action of the chest and through anoxemia if the respiratory depression is sufficiently pronounced. And in return vascular depression probably causes respiratory depression by means of lessened circulation through the respiratory center. Certain it is that the tone of these two functions is apt to run a parallel course in spinal as in regional anesthesia.[3] Moreover, it is easy for a vicious circle to be formed between them, depression of each in turn causing depression of the other.

A third cause of vascular depression, where the anesthesia is quite high, is slowing of the heart. The accelerator fibers to the heart are given off from D 1 to D 5. The rate of the heart is normally maintained by a balance between accelerator impulses coming through these fibers and inhibitory impulses coming through the vagus. When these accelerator fibers are paralyzed by a very high spinal anesthesia, the vagus control becomes unopposed and slowing of the heart results.

A fourth cause of vascular depression is psychic. The process here is similar to that of ordinary fainting from psychic causes.

The occurrence of vascular depression varies with the extent and intensity of the anesthesia and with the characteristics of the patient.

If the anesthesia is limited to the region below L 3, very little effect—and that chiefly psychic—is noted. As the anesthesia becomes higher, the effect on the vascular system becomes greater. The greatest proportional effect is noted in the abdominal area, but this effect is increased as the anesthesia progresses up over the chest when respiratory effects and possibly slowing of the heart are added. If the anesthesia should extend up into the medulla, most marked effects are produced, with cessation of respiration and collapse.

The vascular effect is less with a light anesthesia than with a deep anesthesia of the same extent. The sensory nerves are

more easily affected than are the motor, so that in a light anesthesia, even though the sensory nerves are paralyzed, the motor nerves, and with them the vasomotor, may escape, in part at least. This is not infrequently seen in an abdominal anesthesia. Here there may be complete sensory and motor paralysis in the abdominal area, sensory paralysis extending up over the chest, but little motor paralysis here, as evidenced by activity of the intercostal muscles. Or again an operator may note toward the end of a long operation that relaxation is lessening or coming to an end even though a test after the operation is completed will still show anesthesia well up on the chest.

The amount of vascular effect varies markedly with different types of patients. The young, the vigorous, and those with elastic vascular systems show comparatively little effect, while the aged, the arteriosclerotic, and the feeble show correspondingly severe effects.

The treatment of vascular depression is extremely effective, both in a prophylactic and in a therapeutic way.

1. **Selection of Risk.**—From the facts set forth above it is evident that the risk of different cases of spinal anesthesia will vary between extremely wide limits, and that a fair estimation of the risk may be made beforehand. The first point in prophylaxis, and an extremely important one, is the estimation of the probable risk of the case in hand, and the elimination of the very poor ones. Estimation of the risk is based on the relation between the patient as a risk, and the anesthesia as a risk. Thus hardly any patient is so poor a risk that he cannot safely be given a short anesthesia confined below L 3, but many are too poor for a long anesthesia extending well up on the chest. While an estimation of the risk may be made on the facts set forth above, yet approximate accuracy is a matter of considerable observation and experience.

2. **Preparation of Patient.**—Much may be done in any given case to convert a poor risk into a good risk. The general condition may be improved or specific conditions corrected as for any other anesthesia. One condition requires special men-

tion, as it is of special importance. This condition is dehydration. It is very important that this condition be corrected. *Fluids* are of value not only in dehydration, but even in poor risks where it is not present. The risk of any case, especially a poor risk, is greatly improved by the giving of fluids just before the anesthesia. In such cases we commonly give 1500 c.c. salt solution and 50 gm. glucose by hypodermoclysis just before the anesthesia. Such a patient enters the period of potential depression with the vascular system well filled with fluid, and is correspondingly buttressed against depression. We have found this an extremely useful procedure.

Preliminary narcotics are of some value in preventing or lessening depression due to psychic disturbances in susceptible individuals, besides helping practically all individuals to endure the mental strain of the procedure.

Ephedrine given just prior to the anesthesia is of tremendous help in maintaining blood-pressure. This drug produces a rise of blood-pressure by stimulating the sympathetic nervous system. Thus it to some extent re-establishes activity of the vasomotor nerves which have been blocked out by the anesthesia. There is considerable stimulation of the heart, and an increase in pulse-rate is usually noted. The effect of the ordinary doses lasts one to two hours. As a rise of pressure is produced and as there is a well-marked effect on the heart, some care must be taken that in those with a weak heart too great a load is not placed on it and cardiac failure invited. The dose should be varied to correspond roughly with the length and height of the anesthesia. Less is needed or tolerated if the operation is to be in the Trendelenburg position than if the patient is level. The most generally useful dose is about 50 mg., though half this amount may be sufficient for a low short anesthesia, and 80 to 90 mg. may be needed for a long high anesthesia. We have never exceeded 100 mg. and do not believe it wise to do so.

3. **Placing the Anesthesia.**—It seems hardly necessary to state that the anesthesia should be placed correctly for the contemplated operation. Yet it is undoubtedly true that many patients have been thrown into vascular collapse and have

even died from too high a placement of the anesthesia. In many instances this has resulted from giving a solution, such as "spinocaine," which is lighter than the spinal fluid, with the patient in an upright or nearly upright position. While care should be used to get the correct height with any technic, yet it is necessary to be especially careful when using gravity methods, since by these methods it is easy to send a large amount of the drug high in the canal. While this is very useful if it is correctly done, it is very dangerous if not correctly done, and may then easily result in collapse or death.

4. **Position During Operation.**—When the vasomotor fibers are blocked, the arterial system loses its tone, and the blood-pressure falls. Under these circumstances, if the patient's head is raised, the vascular system may be unable to raise enough blood to the height of the vital nerve centers and collapse may result. Conversely, however, if the head is lowered by putting the patient in the Trendelenburg position, the blood tends to gravitate toward the vital nerve centers and hydrostatic action tends to maintain a higher pressure in them than is present in other parts of the body. It is evident, therefore, that in spinal anesthesia, unless the pressure is well maintained, it is dangerous to raise the head, but that danger is actually lessened by the Trendelenburg position. In upper abdominal operations it is well to place the patient in 3 to 5 degrees Trendelenburg position. The marked Trendelenburg position commonly assumed in lower abdominal operations forms one of the reasons which make these operations relatively safe as compared with upper abdominal operations. Placing the patient in steep Trendelenburg position also forms one of the easiest and quickest steps to improve the blood-pressure on the advent of circulatory depression.

There is one condition, however, in which the Trendelenburg position may not be so safe. This is when the patient is quite heavy and where there are large masses of abdominal fat. When such a patient is placed in Trendelenburg position, the abdominal weight presses against and impedes the motion of the diaphragm. This action may be intensified by the placing

of abdominal packs and the use of retractors. If in addition the anesthesia has reached high enough to interfere with the action of the intercostal muscles, very serious interference with respiration may result. As patients under spinal anesthesia are extremely susceptible to anoxemia, such a restriction of respiration may induce rapid and severe collapse. If in addition any cardiac weakness is present, the condition will be still more serious. Therefore, with patients having very heavy abdomens, it is well to be careful in the use of the Trendelenburg position and to watch their condition especially closely while in this position.

5. **Early Treatment of Depression.**—We have been rather impressed by the fact that if vascular depression has not advanced far, response to treatment is generally prompt and satisfactory, while if it has advanced far response is slow and unsatisfactory. After some clinical observation we have decided that a rough dividing line between these two conditions is formed by a blood-pressure which is two-thirds of the normal preoperative level. It is interesting to note that physiologists tell us that when the blood-pressure sinks to this level or lower, the nourishment and function of the tissues begin to suffer appreciably. Therefore it is well in conducting a spinal anesthesia to keep the pressure at or above two-thirds of the normal level. If this is done, the patient is comparatively safe, as response to simple subcutaneous medication is prompt and satisfactory; while if the pressure is allowed to drop below this point, the patient enters increasing danger, as the circulation in the tissues becomes so slowed that response to subcutaneous medication is unsatisfactory, and the function of the vital organs becomes appreciably depressed. Keeping the pressure above this point is an excellent prophylactic against a severe drop, and an important item in maintaining safety for the patient.

6. **Treatment of Respiratory Depression and Anoxemia.**—In patients under spinal anesthesia a lessening of respiratory volume commonly occurs. Some of the causes for this have already been discussed. Those causes which seem of the most immediate practical importance are the following: (1) In a high anesthesia

the intercostal muscles are frequently paralyzed. (2) While the diaphragm is rarely paralyzed, yet it is often impeded in its action by Trendelenburg position, heavy abdomen, or abdominal packs. (3) When the blood-pressure falls appreciably the circulation in the respiratory center is so slowed that depression of respiration results.

As already stated, depression of respiration may affect the circulation by means of mechanical effects and through the medium of anoxemia. Clinically the blood-pressure is affected distinctly by changes in respiration. There seems to be a critical point, probably when a certain degree of anoxemia has been reached, beyond which the pressure recedes very rapidly. A patient may go along very well to superficial observation, the blood-pressure being well maintained, but may in reality be acquiring a gradually increasing anoxemia. Under these circumstances all will apparently be well till this critical point is reached, when there will be a sudden severe drop in pressure.

Close observation of the respiration and color, with the administration of oxygen and sometimes carbon dioxid as indicated, will prevent or mitigate such a fall in pressure. These measures may also be of some help in raising the blood-pressure after it has once fallen.

A word of warning, however, is necessary. While the maintenance of efficient respiration and the prevention of anoxemia are excellent prophylactics and even good aids to therapeusis, it is dangerous to rely on them for more than this. If the blood-pressure has really dropped, it is most readily restored by treatment directed to the circulation. Even though treatment directed at the respiration may be an important adjunct, yet it is only an adjunct and must not interfere with treatment directed toward the primary and most important seat of trouble—the circulation.

7. **Competent Watching.**—It should be unnecessary to state that if significant changes in the patient are to be detected early and if appropriate treatment is then to be instituted, someone should be watching the patient who is competent to observe carefully and carry on the treatment. Yet so many deaths have

occurred for lack of just such a person that it seems well to stress the point. Some of the changes, such as those due to depressed respiration, may not be strikingly evident, and require careful observation to detect and experienced judgment to interpret. Some experience and judgment are necessary to determine when treatment should be started and how vigorous it should be.

It is well, therefore, to have at the head of the table an experienced anesthetist. Such a man is of great value in detecting early mild symptoms and preventing severe ones. Should these latter occur he will be of great value in the emergency treatment to be detailed later. Incidentally, he will be of value should a general anesthetic become necessary to quiet the nervous condition of the patient or to piece out a long anesthesia.

8. **Epinephrine.**—If circulatory depression comes on, the one measure which is of the greatest value is the use of epinephrine. This drug may be given in varying doses and different ways according to the amount of effect desired. Where the depression is slight and a mere supporting effect is wanted, 0.1 to 0.2 c.c. subcutaneously, is sufficient. Where the depression is greater, 0.2 to 0.4 c.c. may be used. Where the circulation in the tissues is considerably slowed, absorption will be hastened either by the use of massage at the point of injection or by making the injection intramuscularly or by both. If the circulation in the tissues is very much slowed up, reasonably quick absorption will not take place without considerably increasing these doses. If this is done the whole dose will be rapidly picked up as soon as the circulation has improved, and a very marked rise in blood-pressure, far above normal, will result. This is undesirable. It is much better to give a small dose early, when it will be quickly picked up, and thus keep definite control of the patient. Another reason for starting with a small dose given early is that the response of different individuals to epinephrine varies. This procedure gives opportunity, if necessary, to repeat or increase the dose, whereas a large dose cannot be cut down.

If extreme circulatory depression or collapse should occur,

the subcutaneous or even intramuscular administration of epinephrine would be inefficient, as absorption would be too slow to meet the emergency. So in these circumstances intravenous administration becomes necessary. The initial dose should be small, about 0.1 c.c., as the effect is almost instantaneous and very powerful. This may be repeated or increased or, once the circulation has been improved, the effect may be carried on through giving it by the subcutaneous route or in saline infusion.

In the event of complete or almost complete stoppage of the circulation, even the intravenous administration becomes ineffective. Epinephrine, therefore, must be given directly into the heart. This may be done with a fine needle about 6 cm. long, going in at the fourth left interspace about 4 cm. to the left of the sternum. If the heart is beating, this will be felt in the needle, but if it is not beating, entry into the heart may be verified by aspirating a little blood into the syringe. Usually 0.2 to 0.3 c.c. will be enough to start the heart going.*

9. **Fluids.**—These are of value not only in the preparation of the patient, but also in the treatment of vascular depression. Salt solution is effective and should be given intravenously. If the circulation has become extremely slowed, salt solution will hasten the effect of epinephrine given intravenously by washing it toward the heart.

10. **Co-ordinating Treatment.**—In all but the most severe forms of depression the situation should be handled readily by the anesthetist without the help of other members of the operative team. In the event of real collapse, however, the urgency of the situation demands that the combined and properly co-ordinated efforts of the entire team be brought to bear on the patient.

In order that this may be done promptly and effectively, two things are necessary. First, there should be adequate equipment on hand. Second, the efforts of the team should be properly co-ordinated.

* We have had one case, reported on p. 1341, with perfect recovery, in which these measures were used for collapse from air embolism under a general anesthetic.

For equipment the anesthetist should have a gas machine handy for the administration of oxygen, and a hypodermic syringe and epinephrine. The use of these latter has already been discussed. Another syringe should be ready on the surgeon's instrument table, together with two needles, hypodermic and cardiac, and an ampule of epinephrine. It is presupposed that the hospital has at all times apparatus ready for saline infusion.

The efforts of the team should be co-ordinated by some one individual. As immediate charge of the condition of the patient is in the hands of the anesthetist, it is logical that this should be done by him.

When the anesthetist, who is watching the patient, sees that a condition has arisen so urgent that the rest of the operative team should be called upon, he should immediately give the alarm. He should at once put the patient in marked Trendelenburg position, if she is not already so placed and if she is not over-stout; he should give oxygen and, if necessary, artificial respiration, keep an open airway, watch the patient's condition, and decide what further treatment her progress indicates.

Meantime, the instant the alarm is given by the anesthetist, the operative nurse should fill the syringe on the instrument table with epinephrine and pass it to the surgeon. At the same time, when the alarm is given, the surgeon looks over his operative field for an appropriate vein, and when the syringe is received from the nurse, injects epinephrine into the vein. Should the collapse be complete and the heart be stopped or practically so, he should request the cardiac needle and inject directly into the heart instead of a vein. If the heart has stopped and does not immediately start on the injection of epinephrine, it should be massaged. If an abdominal operation is in progress, the surgeon can do this through the diaphragm; otherwise he may do it by making a stab wound an inch long in the third left intercostal space, about 1 inch from the sternum and by hooking the index finger around the heart, according to the method of Babcock.[4]

The above measures attack both the respiration and the circulation at the same time and with great promptness, and

should prove quite effective. Further measures will depend on the condition of the patient. A saline infusion would probably be indicated. The most important point, however, is that some support be gotten to the circulation quickly. Speed here is vital, to get help to the circulation before it has gone too far to respond readily or before vital tissues have begun to suffer seriously from anemia. This is the chief point that the above plan aims to cover.

Summary.—The vascular depression of spinal anesthesia is caused mainly by vasomotor paralysis, but is increased and may be precipitated by respiratory depression. It may be largely prevented by proper selection of cases, preoperative fluids, and ephedrine, care in placing the anesthesia, and Trendelenburg position during operation. The patient should be very closely watched by a competent anesthetist and respiratory depression treated with oxygen and sometimes carbon dioxid. Epinephrine is by far the most powerful and valuable therapeutic agent, though fluids are also of value. The importance of early treatment is stressed and a plan is presented for concerted and coordinated effort in case of emergency.

BIBLIOGRAPHY

1. Sise, L. F.: New England Jour. Med., 200, 1071–1074, 1929.
2. Rygh, E. A., and Bessessen, D. H.: Minnesota Med., 11, 744–747, 1928.
3. Isenberger, R. M., Rowntree, L. G., and Lundy, J. S.: Proceed. Staff Meet., Mayo Clinic, 3, 294–297.
4. Babcock, W. W.: Anesth. and Analg., 3, 208–213, 1924.

CLINICAL IMPRESSIONS OF TWO NEW ANESTHETICS: SODIUM AMYTAL AND AVERTIN

LINCOLN F. SISE

Two substances have recently been brought into use which, while not strictly new, are at least new in their use as anesthetics in this country. These substances, sodium amytal and avertin, are similar in that they produce general anesthesia by another than the inhalation route.

Sodium amytal is sodium iso-amylethyl barbiturate. It is a white powder very easily soluble in water. Its action is believed to be much more desirable when it is in a very pure state and is given (intravenously) at just the right hydrogen-ion concentration. It has, therefore, been prepared in very pure form and put out in two ampules for intravenous use. One ampule contains the salt and the other contains a sufficient amount of triple distilled water to make a 10 per cent. solution, and at the correct hydrogen-ion concentration. The salt dissolves easily with the evolution of many fine bubbles. When these pass off, however, the solution should be quite clear, not opalescent.

Its administration intravenously should be quite slow, approximating a rate of about 1 c.c., equivalent to 100 mg. of the salt, per minute. While the first few cubic centimeters may be given a little more rapidly than this, it is well to give the last part of the dose as slowly as this or even a little slower. Anesthesia comes on rapidly and apparently without disagreeable sensations. Frequently the patient is unaware of its approach.

During injection the blood-pressure usually falls, the extent of the fall depending on the size of the dose, the rapidity of its administration, and the vigor of the patient. It is usually but moderate, and is followed by a slow recovery to normal. The breathing is quiet and shallow, and usually is clear in a light

anesthesia, but in one of more than slight depth it may be obstructed by falling of the tongue back in the pharynx. The pulse may be slightly increased in rate. Reflexes are present till considerable depth is attained. The skin reflex especially appears to be very active in a light anesthesia. In light anesthesia, especially with vigorous subjects, there is a tendency to motor restlessness. This is easily elicited by stimulation of the skin, such as pinching or pricking. This feature is of value when this anesthesia is combined with spinal anesthesia. Sleep is prolonged postoperatively for several hours in proportion to the size of the dose used; and there is a well marked tendency to somnolence for a day or two thereafter.

The dose may be roughly calculated by the body weight of the patient. It will vary from 5 mg. per kilo for a very light anesthesia, up to 25 mg. per kilo (up to a total of about 1.6 gm.) as a maximum dose not to be exceeded even for a very deep anesthesia. This calculated dose should then be changed according to the age, vigor, and build of the patient. A still further approximation of the correct dose may be made by watching the effect of the injection while it is being made.

Avertin, or E 107, is tribromethylalcohol. It is a German preparation and has been used in a considerable number of cases in that country, and is now just being introduced in America. It is a white crystalline powder soluble in water at 40° C. up to $3\frac{1}{2}$ per cent. It is slowly decomposed by light and air and so must be protected from them. When in solution it is rapidly decomposed by temperatures about 40° C. with the formation of hydrobromic acid and dibromacetaldehyde. The latter is highly injurious to the intestines even in small amounts.

Avertin is usually administered in 3 per cent. aqueous solution by rectum. The correct amount of avertin is weighed out and mixed in a flask with the proper amount of distilled water to make a 3 per cent. solution. This mixture must be kept at a temperature of 35° to 40° C. and agitated frequently to aid solution. This usually takes about fifteen minutes. Avertin may be obtained in another form as avertin fluid. This is more convenient to use and goes into solution in water much more

quickly. Even this, however, requires a little time and agitation. A water-bath is advisable in making the solution, as the drug dissolves more quickly if the solution is kept at or above 35° C. and as it is important that the solution should not be brought above 40° C. because of the formation then of dibromacetaldehyde.

In the early use of avertin this decomposition product was probably formed a number of times, and severe injury to the intestine resulted. It is, therefore, very important that the solution be kept within the specified limits of temperature and that it be tested just before use. This test may be made by adding to 5 c.c. of the solution 1 or 2 drops of a 1 : 1000 aqueous solution of congo red. The resulting color should be a clear orange red. A blue color indicates decomposition and means that the solution should be discarded.

The solution should be given at about body temperature through an ordinary rectal tube and funnel. It may be run in quite quickly, as no cramps or other discomfort are experienced by the patient, beyond those mechanically caused by the rectal tube. No preliminary cleansing of the rectum is necessary. The drug is absorbed more rapidly than the water in which it is dissolved, and anesthesia comes on with surprising rapidity. We have seen the patient sound asleep with loss of lid reflex in as little as two minutes. More commonly, however, it takes five to ten minutes, and in resistant subjects it may be longer.

The effect of the anesthesia is apt to be relaxing and depressing. The blood-pressure falls and the pulse usually is slowed. In susceptible individuals the fall in pressure may be very severe. In two instances, in arteriosclerotic and hypertensive individuals, we have seen a fall from a preoperative level of 230 to 240 systolic, down to 70 to 80, requiring close and prolonged postoperative attention, but in each case with good recovery. Respiration is depressed and there is frequently obstruction from dropping of the jaw. Muscular relaxation is pronounced, and there is no tendency to motor restlessness. Anesthesia is prolonged, but less so than is the case with amytal, and there is less tendency to postoperative somnolence.

The usual dose is 80 to 100 mg. per kilo of body weight, more or less, depending on the vigor and resistance of the patient.

We have not used these drugs in a large series of cases, yet our limited experience with them has been sufficient to give us some rather decided clinical impressions. They seem to us to have a very definite, though somewhat narrow field of usefulness. The field is that of a light prolonged anesthesia or as a "basal anesthesia." By "basal anesthesia" is meant an anesthesia which acts as a basis or foundation on which may be built a further and deeper anesthesia. Thus a light anesthesia may be obtained with one of these drugs and then nitrous oxid used in addition. In this way a depth of anesthesia may be obtained which is usual for nitrous oxid or deeper, and yet without any anoxemia or cyanosis. Thus they rid nitrous oxid of one of its chief drawbacks. The combination affords a beautiful anesthesia of moderate depth.

Both these drugs appear to be unsuitable for the production of a really deep anesthesia alone. The margin between the minimal lethal dose and the dose for deep anesthesia is too narrow. Avertin is too depressing. The dose of each is largely fixed and cannot be lessened should alarming symptoms appear. While some avertin may be withdrawn from the rectum, if necessary, the procedure is uncertain, especially after the first few minutes.

They are, however, very suitable and satisfactory when a prolonged light anesthesia is desired. We have liked them particularly in many orthopedic operations on the extremities, such as tendon transplantations, arthroplasties, and the like, with the application of extensive plaster casts. Here the prolonged light anesthesia, the muscular relaxation, and the prolonged period of postoperative quiet afforded by avertin have seemed almost ideal.

They have been useful also in operations on the trachea and larynx. Here the lack of interference between the surgeon and anesthetist and the freedom from inflammable vapors, permitting the use of cautery, have been of advantage. Our experience in this field, however, has been very limited.

One of their most useful fields has been that of a preliminary narcosis or basal anesthesia, on which is superimposed one of the more common anesthesias, such as nitrous oxid, regional or spinal anesthesia. Either of these two drugs go well with nitrous oxid. With regional or spinal anesthesia sodium amytal is to be preferred. It is of advantage with regional anesthesia because of its marked protective action against the toxic effects of the drugs of the cocain-procain series. When a full dose of sodium amytal has been given beforehand, three or four times the ordinary convulsive dose of the drugs of this series can be given without producing convulsions. When sodium amytal has been used as a preliminary to spinal anesthesia, even though the patient has been made completely unconscious, anesthesia can readily be tested for because of the retention of complete skin sensitivity. Indeed, it frequently appears as if there were really skin hyperesthesia. Avertin seems to be altogether too depressing to make its use safe with spinal anesthesia.

While our somewhat limited experience does not permit us as yet to be perfectly definite on this point, yet it has seemed to us that avertin acted very favorably in cases of hyperthyroidism. These excitable patients may be put definitely asleep in their beds and thus spared the period of greatest apprehension just before operation. The depressing action of the drug tends to lessen the vascular excitation with quickened pulse and increased blood-pressure which usually occurs during anesthesia. And the postoperative action of the drug usually tends to lessen postoperative restlessness. Most of these patients tolerate a somewhat larger dose than normal individuals, and their recovery is somewhat quicker.

In a limited way these two drugs appear to be complementary in their field of usefulness. Sodium amytal, because of its tendency to produce motor restlessness, is often not satisfactory with the vigorous and resistant, while avertin, because of its depressing effect, is unsafe to use with the feeble and asthenic. In the reverse conditions, however, they act admirably, amytal being suitable for those with low vigor and resistance and avertin

being suitable for those with high vigor and resistance, especially where the metabolic rate is increased.

These two drugs are a boon to the very nervous or apprehensive patient, especially where regional or spinal anesthesia is to be used. They can readily be given in the patient's bedroom, thus saving him the nervous strain of the trip to the operating room and the period there just before operation. Induction is very free from disagreeable sensations, the patient often falling asleep without realizing that he is doing so. They are especially useful in case of emergency where there is not time for a full course of the more usual narcotic drugs such as morphin and scopolamin.

Summary.—Sodium amytal or sodium iso-amylethyl barbiturate given intravenously and avertin or tribromethylalcohol, given by rectum, are each suitable for obtaining a preliminary narcosis, a prolonged light anesthesia, or a basal anesthesia. They are unsuitable used alone for deep anesthesia.

They have the advantages that their induction spares the patient some preoperative apprehension, they produce a prolonged anesthesia without apparent detriment to the patient, and they aid other anesthetics in the production of a deep anesthesia. In suitable cases the depressing effect of avertin may be of advantage. This drug has the advantage over oil-ether in that it is quicker and cleaner, does not require cleansing of the rectum, and does not induce intestinal cramps.

Both these drugs have the disadvantages that they are somewhat time-consuming, that the anesthesia, once established, is to a large extent fixed and cannot be changed to suit the condition of the patient, and that the postoperative recovery is prolonged.

Of the two, sodium amytal is less depressing, less relaxing, and slower in recovery. Avertin is depressing and in susceptible individuals may produce a severe drop in blood-pressure.

On the whole, they appear to have a very definite though somewhat narrow field of usefulness. They provide two more opportunites for choice which the careful anesthetist may use in fitting the anesthesia to the individual needs of a given patient.

CHOICE OF ANESTHESIA

LINCOLN F. SISE AND P. D. WOODBRIDGE

WHILE there are a great many considerations which may influence the choice of anesthesia, there is one which should dominate all others. This is the safety of the patient. And by this term is meant his safety not as far as anesthesia alone is concerned, but as far as the whole procedure is concerned—anesthesia, operation, and convalescence.

One of the factors which has a well marked influence on safety is the toxicity of the anesthetic agent. It is well, therefore, at the start briefly to review the various commonly used anesthetics and see which has the least effect on the various body tissues and functions and which the most.

There is no doubt that procaine given by the various methods of regional anesthesia and by spinal anesthesia, heads the list, as it has very little toxic action. Moreover, what toxic action it has is in the form of a temporary disturbance of function rather than in the form of a definite tissue change. It should therefore be used where other considerations make it practical.

By the term "regional anesthesia" is here meant the anesthesia produced by procaine, whether it be by local infiltration, field block, or nerve block. While spinal anesthesia is in reality a form of regional anesthesia of the nerve block variety, yet its characteristics are so different from the other forms of regional anesthesia that, for convenience, it will be considered separately.

Ethylene stands next to procaine in toxicity, with nitrous oxid not far behind. Nitrous oxid has virtually no toxic action in itself, but may produce deleterious changes[1] by reason of the anoxemia which invariably accompanies its use[2] unless some narcotic or other anesthetic agent is combined with it in sufficient quantity. The term "gas" will be used here to denote either ethylene or nitrous oxid.

Ether shows well-marked toxic action on the function and substance of most of the important organs of the body. It lowers the function of and produces tissue changes in both the liver and kidney.[3] The effect on the latter, however, appears to be due in a large measure to vasoconstriction and can be prevented to a considerable extent by the preliminary use of morphine.[4] It may produce tissue changes in the heart and central nervous system. It produces metabolic changes tending toward hyperglycemia and acidosis. It is irritant to the respiratory passages. It is apt to be followed by nausea and vomiting.

On account of these various toxic actions it is desirable to use other less toxic anesthetics whenever it is practical to do so.

Ethyl chloride and chloroform stand next in order of toxicity. The deleterious effects of these two are very similar, but that of ethyl chloride is somewhat less than that of chloroform. The most marked toxic action of chloroform is on the vascular system, the function of which usually shows well marked depression, and on the liver, whose substance may be severely injured. Indeed, these two substances are so toxic that they should be avoided as far as practical.

The relative position in this list of the two new substances, avertin and sodium iso-amylethyl barbiturate, which are discussed more in detail on page 1381, is uncertain at present. It appears that they are of relatively low toxicity.

Preliminary narcosis is not generally considered to be an anesthesia. Yet it is at least a great aid to anesthesia and may even be pushed to the point of becoming an actual anesthesia itself. In fact, there is no sharp dividing line between the two conditions. The two substances last mentioned, avertin and sodium iso-amylethyl barbiturate, well illustrate this, as they may be given to produce any condition from light narcosis to deep anesthesia.

A second factor which may well modify or change the safety of any given anesthesia is the patient himself, his physical characteristics and pathology. Thus we may decide that one of the gases is safest for a frail and asthenic individual, but that spinal or even ether anesthesia would be best for a robust and vigorous

individual undergoing the same sort of operation. Ether, while suitable for certain operations in normal individuals, might be particularly dangerous for the same operation in individuals showing disease of the respiratory system, liver, or kidneys.

In hypertension of the essential form, regional or spinal anesthesia are acceptable as they avoid the rise in blood-pressure so frequently seen under the general anesthetics, but in the arteriosclerotic form, spinal anesthesia should be used only with great care and may even be contraindicated.

Hypotension from pathological causes is usually a contraindication for spinal anesthesia. But robust individuals who normally run a low blood-pressure present one of the very best risks for it.

Well compensated valvular heart disease affects the choice of anesthetic hardly at all. In all other forms of heart disease it is well to avoid as far as possible a rise of blood-pressure. Spinal anesthesia is, therefore, to be preferred to the inhalation anesthetics where practical. With any considerable degree of myocardial disease, however, spinal anesthesia should be used only with great caution or should be avoided entirely, leaving regional anesthesia as the method of choice.

While ether should usually be avoided in disease of the kidney, yet if other considerations cause its use, it should be preceded by morphine, as this latter to a considerable extent, prevents kidney damage by lessening the injurious renal vasoconstricting effect of ether.

In disease of the liver ether is injurious, as is also the anoxemia which usually accompanies gas anesthesia. In severe liver disease, as in obstructive jaundice, ether may prove so injurious that it may well turn the scale against the patient. Here regional or spinal anesthesia are much to be preferred.

Where shock is present, regional or light gas anesthesia are to be preferred, ether or spinal anesthesia usually being contraindicated because of their depressing effect on the circulation.

A third factor which influences the safety of an anesthetic, and one which influences it quite decidedly, is the site of the proposed operation.

In abdominal surgery, as the site of operation is reached through a muscular wall, and as very sensitive structures are frequently encountered, there is need of an anesthesia which will suppress powerful reflexes and produce good muscular relaxation. Such an anesthesia increases safety because it facilitates the performance of the operation and because the reverse conditions, straining and rigidity, hamper the operation, may, in extreme cases, even prevent its proper performance, and may introduce still further dangers due to protrusion and excessive handling of viscera and the consequent spreading of sepsis.

Spinal anesthesia admirably meets this situation. The combination which it affords of extreme relaxation, contracted intestines, and quiet breathing, offers operative conditions unrivaled and hardly even approached by any other form of anesthesia. These conditions are especially valuable in the very muscular or obese patient, and in very difficult or critical operations. Moreover, the absence of toxic action on the tissues by spinal anesthesia makes it extremely valuable for the patient handicapped by disease of the lungs, liver, kidneys, or heart. In difficult operations or with handicapped patients, and especially where both these conditions are present, we believe the total mortality from anesthesia and operation to be lower and the surgical results better with spinal than with any other form of anesthesia.

The combination of successful spinal anesthesia and effective preliminary narcosis is almost ideal. The patient falls quietly asleep, often without realizing it, and wakens after his return to bed with the operation completed, having had an anesthesia which gives the minimum of organic toxic effects and the maximum of desirable operative conditions.

However, spinal anesthesia has certain dangers inherent in itself. These are discussed in greater detail on page 1369. There it is shown that, under different situations, the danger varies within quite wide limits. Therefore, in situations where the danger is greatest, or where the patient is an easy and favorable subject for other forms of anesthesia, with simple operations, or with patients not handicapped, the advantage of spinal anesthesia

may be less marked, lost, or even reversed. The latter is the case, and therefore spinal anesthesia, especially a high anesthesia, should not be used where the patient is seriously debilitated, whether it be from acute causes, especially shock, or from prolonged illness. Surgical intervention in these cases is often urgent, and deep relaxation may well be foregone in order to relieve the patient from the danger which its production usually entails. Here anesthesia by field block is to be preferred, with the addition, if necessary, of one of the gases.

Spinal anesthesia should never be given unless administered with great care and guarded with every precaution. Where no one well versed in its administration is available, regional anesthesia perhaps with one of the gases, or one of the gases with variable amounts of ether, or ether anesthesia alone, may be used, depending on the character of the patient and operation—the first mentioned anesthetics being used for the more frail subjects and easy operations, and the last being used for the more vigorous subjects presenting no contraindication to ether, and for the more difficult operations. Ether continues to occupy an important place in abdominal surgery, since it is well tried and tested, has been the standard for many years, is always available, as it may, under necessity, be given even by a novice, gives good relaxation, and is safe as regards immediate effects.

For operations on the trunk (exclusive of the abdominal cavity) and on the extremities, deep relaxation is seldom needed, except in a few instances to be mentioned later, and ether is therefore seldom indicated. Either nitrous oxid or ethylene on the one hand, or regional or spinal anesthesia on the other, cover practically every need. For many of the operations the gases or regional anesthesia are equally applicable, so that choice is to be made on the basis of minor factors, such as the preference or convenience of the patient or surgeon. These are mostly superficial operations. For certain other operations, while a choice of methods is available, yet some one method is preferable. Thus in bone surgery where there is cutting, hammering or sawing, the patient is often distressed by these procedures if he is conscious, even if he feels no pain. Therefore one of the

gases is here preferable. In operations on the anus and rectum and, to a less extent, in operations on the urinary bladder, the relaxation afforded by regional or spinal anesthesia is of such value that here they are preferable. A truly low spinal anesthesia, one which is comparable in extent to a sacral anesthesia, is so safe that there is little choice between the two. Spinal anesthesia is also safe and, in handicapped patients, is suitable for extensive operations on the lower extremities, such as amputations.

In thoracic surgery, when the pleural cavity is to be opened, the expansion of the lungs should be maintained by the administration of one of the gases under accurately controlled pressure.

Operations on the head and neck are characterized by the fact that there may be interference between the surgeon and anesthetist and that, except where the mouth is to be opened, little relaxation is needed. In many operations, such as those on the thyroid, mastoid, and cervical lymph-nodes, even though the fields of the surgeon and anesthetist lie close together, yet, if care is used in draping, gas anesthesia may be used to advantage. It may also be used by means of a nasal inhaler for operations in the mouth and for some on the face.

In the majority of operations, however, especially in those about the head, the presence of the usual surgical inhaler or even of a nasal inhaler interferes too much with the work of the surgeon. Here regional anesthesia is very desirable. Operations on the scalp, cranial vault, or brain, superficial operations on the face, and practically all operations in the mouth, nose, and nasal sinuses may be done under combinations of infiltration, field block, or nerve block. In surgery of the anterior part of the neck, regional anesthesia is also applicable as well as gas, various combinations of cervical plexus block, field block, and infiltration giving satisfactory anesthesia for most of the usual operations. In thyroidectomy the addition of a brief general anesthesia is helpful while the lobes are being elevated from their beds. In all these operations, the discomfort caused by the position on the table, by drapings, and by the location of the

operation should be prevented by the free preliminary use of narcotic drugs. Regional anesthesia is difficult to use in the posterior aspect of the neck, and should not be used in any location where the needles may have to traverse infected tissues.

Whenever it is desired not to use regional anesthesia, pharyngeal or intratracheal insufflation may be used. Ether is usually most suitable, as its application is simple and easy and, because only a very light plane of anesthesia is needed, the toxic effects are mild; but if desired it is possible to use one of the gases. With insufflation, interference between the surgeon and anesthetist is reduced to a minimum, and inhalation of blood and detritus is prevented by the gaseous currents and by proper packing. The intratracheal method may also be used without insufflation by using a large, tight-fitting catheter after the method of Flagg or of Waters and Guedel.

Colonic ether may also be used or either of the two substances described on page 1381. These three are particularly valuable for operations where a tracheotomy has previously been performed as well as for operations done through the esophagoscope or bronchoscope.

Summary.—While there are a multitude of factors which influence the choice of anesthetic in each case, yet in general the choice is governed by a few broad considerations. Of these the safety of the patient is paramount.

Of the more commonly used drugs, procaine is the least toxic and ether by far the most toxic, ethylene being the least injurious of the inhalation anesthetics. One or another of these may be most suitable in a given case, according to the characteristics of the patient.

For abdominal operations, spinal anesthesia is preferred where technical difficulties are anticipated, and field block by procaine, reinforced, if necessary, by one of the gases for patients in poor condition. In others, gas, ether, regional or spinal anesthesia may be used, but the choice among these methods will be less definite and will depend upon a variety of factors.

For most operations on the trunk and extremities, either procaine, including its intraspinal administration, or one of the

gases may be used. Ether is rarely indicated. For operations on the anus, rectum, and urinary bladder, regional and spinal anesthesia are preferred because of the deep relaxation which they afford.

Gas anesthesia is quite suitable for operations in the region of the neck. For most operations on the head and neck, interference between surgeon and anesthetist may be lessened or eliminated by one of a considerable number of methods, such as regional, pharyngeal, intratracheal, rectal, or intravenous anesthesia.

BIBLIOGRAPHY

1. Rosenthal, S. M., and Bourne, W.: Jour. Amer. Med. Assoc., 90, 377–379. 1928.
2. Greene, C. W., et al.: Arch. Int. Med., 35, 371–378, 1925. Greene, C. W., and Curry, H. M.: Arch. Int. Med., 35, 379–388, 1925.
3. Stander, H. J.: Amer. Jour. Obs. and Gyn., 12, 633–654, 1926. Yates, J. L., and Raine, F.: Ann. Surg., 87, 124–129, 1928.
4. Haines, W. H., and Milliken, L. F.: Jour. Amer. Med. Assoc., 85, 1853–1855, 1925. Jour. Urol., 17, 147–153, 1927.

NOTES ON APPENDICITIS—CHRONIC AND ACUTE

FRANK H. LAHEY

HARDLY anyone writes today about the subject of appendicitis without an apology, and yet it has been stated that the mortality of this disease has increased rather than decreased in the last five years.

The subject of chronic appendicitis has now been under critical consideration for a sufficiently long period of time so that it is now possible to place it in a position somewhere near that in which it belongs. As has been the case with nearly all new surgical operations, such as oöphorectomy in the time of Spencer Wells, gastro-enterostomy, and bone plates, appendectomy for a period of years acquired a popularity which carried it far beyond its scope of usefulness in many instances, among those being particularly appendectomy for so-called chronic appendicitis.

The abuse of oöphorectomy, gastro-enterostomy, and bone plates has with time and the general improvement of surgery, corrected itself, and so in a similar way the abuse of appendectomy for chronic appendicitis is correcting itself. We have observed the uncritical diagnosis of chronic appendicitis for almost any pain in the right iliac fossa, and practically every case in which there was tenderness in the right iliac fossa. The end-results of these ill-advised operations and the abuse of the operation for so-called chronic appendicitis led many surgeons to state that there was no such thing as chronic appendicitis. This we believe is not a fact. While it is true that a very great number of the patients operated upon under the diagnosis of chronic appendicitis do not have such a lesion and are not benefited or relieved of their symptoms by such appendectomy, nevertheless there is a non-acute condition of the appendix which produces symptoms and from which the patient can be freed by ap-

pendectomy. We should not, we believe, assume the position that there is no such thing as chronic appendicitis, and today, at the end of a period of critical estimation of the value of appendectomy in non-acute right lower quadrant symptoms, we must assume that there actually is a fair middle ground between the two extremes.

We have repeatedly written and stated that in a patient who has had an obvious attack of acute appendicitis for which he has not been operated upon and who, previous to the acute attack has had no pain or discomfort in the right lower quadrant, where following this attack, persistent or recurrent attacks of pain occur in the right iliac fossa over the appendix region, a clinical diagnosis of chronic or recurrent appendicitis may be made and appendectomy advised with reasonable assumption of relief for the patient. Only under the above conditions, we believe, can the clinical diagnosis of chronic or recurrent appendectomy be made.

x-Ray evidence as to the possible presence of chronic or recurrent appendicitis is limited, in our opinion, to tenderness directly over the appendix by fluoroscopy. When, with the appendix visualized by a bismuth enema, definite tenderness over the visualized appendix can be elicited, and when also there is a direct history suggesting the possibility of this lesion, this is evidence of value in the diagnosis of chronic or recurrent appendicitis. *x*-Ray evidence other than that described above we have always held as of little value. The presence of kinks in the appendix, the fact that the appendix does not move freely by fluoroscopy, a retrocecal position of the appendix, and failure of the appendix to fill or to fill completely are not dependable features as indicating the presence of chronic or recurrent appendicitis.

As evidence of the fact that *x*-ray pictures showing a probably adherent appendix are not dependable evidence of the presence of chronic appendicitis is the fact which we have often stated, that very frequently at other operations, such as gallbladder, stomach, pelvic, etc., appendices are found which are so kinked, adherent, and abnormally placed that they would

surely give *x*-ray evidence of the so-called pathologic appendix, yet the history of the patient gives no evidence that any discomfort was suffered by the patient as the result of the presence of such an appendix.

We have, therefore, assumed the position in the clinic that, except where an acute attack of appendicitis without operation is followed by recurrent attacks of pain and tenderness in a patient who previous to the attack did not have right lower quadrant pain, and in those patients with right lower quadrant pain and tenderness localized by fluoroscopy to the appendix itself, a clinical diagnosis of recurrent appendicitis cannot be made. In such cases we endeavor to rule out all possible causes of right lower quadrant pain, one of the most common of which is spastic colitis as the result of the prolonged use of cathartics. If, in spite of all non-operative measures to relieve the patient of the pain it still persists, operation must be performed only as a possible measure of relief and considerably in the nature of an exploration; otherwise the end-results will, by no means, justify the procedure.

Acute appendicitis occurs in such bizarre forms that it is not possible to discuss its various demonstrations of its presence. The most typical appearance of acute appendicitis is that which starts in either the left side or epigastrium and eventually localizes in the right lower quadrant. Any patient with such a history, together with right lower quadrant pain, quite typically has acute appendicitis.

We are not interested particularly in rehearsing the features of acute appendicitis, but rather in presenting some of the difficulties which have caused us to be uncertain as to the diagnosis of this lesion.

No patient suspected of having acute appendicitis should ever be left without a rectal examination. Not infrequently have we seen the entire abdomen quite negative as to tenderness, only to find definite tenderness by rectal examination, and due to the fact that the acute process occurred in an appendix which was so deep in the pelvis that abdominal palpation failed entirely to elicit tenderness.

One should be extremely suspicious that patients with high temperature, but without tenderness, spasm, and pain histories of proportionate magnitude are not cases of acute appendicitis. One occasionally sees patients with indefinite right iliac fossa discomfort, with indefinite right iliac fossa tenderness, and without definite spasm, but with temperatures of 102° to 103° F. If such a temperature is due to acute appendicitis, there will rarely be any doubt as to the presence or absence of proportionately acute physical signs of the disease.

There is another type of appendicitis which has occasionally occurred in our experience. That is an intramural inflammatory process which occurs in the walls of the appendix without pain. We have occasionally seen such types of appendicitis in which the first indication to the patient of the presence of the disease was a very moderate amount of right lower quadrant tenderness present, but with no pain whatever, while at this time a definite indurated mass, consisting of either an indurated appendix or an appendicitis with abscess could be felt on palpation. Fortunately appendicitis of such character is apparently of such low-grade inflammatory character that there is sufficient time for walling-off adhesions to form and little likelihood of perforation into the general peritoneal cavity.

Another situation which has occasionally been confusing and of difficult decision is the association of diarrhea and indefinite right lower quadrant pain at the same time. In our experience the association of diarrhea and acute appendicitis has been extremely rare and one should be exceedingly suspicious that, unless the symptoms are quite typical in character, the pain and tenderness are considerably more apt to be caused by the condition bringing about the enteritis than by appendicitis.

In young children suspected of acute appendicitis, a careful search for movable tender masses in the right lower quadrant should always be made with the possibility that the lesion may be a tubercular process with mixed infection in the mesenteric glands at the junction of the ileum and cecum. In such cases *x*-ray not infrequently demonstrates the shadows of calcium deposits in the glands.

In the operative management of acute appendicitis there are a few facts which we have found of importance, but concerning which but little has appeared in the literature. One of the fixed rules which we have made in the clinic in the operative treatment of acute appendicitis is that all acutely inflamed appendices which are fixed either in the pelvis or to the posterior abdominal wall shall be removed under direct vision. The reason for this is that one can by this procedure be certain of protecting the surrounding peritoneum by walling-off packs and can visualize any intestinal contents which may escape, particularly through perforations at or near the base as soon as the appendix is separated away from its adhesions to the postparietal peritoneum.

In dealing with all adherent acute appendices, one should always have in mind that in those cases in which a necrotic area at the base of the appendix has caused a perforation at this point (near the base), the dangers of fatal contamination are much more possible than when perforations have occurred nearer the tip of the appendix. If such a localized area of necrosis has occurred, as it not infrequently does in acute appendicitis, and the adhesion of the area to the postparietal peritoneum has prevented perforation at this point, then if this inflamed appendix be freed digitally and without exposure, there will be an escape of most of the fluid fecal content of the cecum with wide peritoneal contamination before it can be prevented.

As almost everyone realizes, the nearer the tip of the appendix perforations occur, the less danger there is of an outgush of liquid cecal content filled with organisms of highly virulent character. Fortunately the localized inflammatory appendiceal lesions occurring elsewhere in the appendix than at the exact base tend to so occlude the lumen of the appendix that this accident cannot occur.

It is for the above reason that all adherent acute appendices are exposed by careful walling-off of the intestines and by adequate retraction. With the adherent appendix then well visualized, it is gently separated from the postparietal peritoneum with a small strip ready to be immediately placed over a discharg-

ing perforation if it appears, with the remainder of the peritoneal cavity carefully walled-off by gauze packs and with a suction apparatus at hand to take up any excessive amount of escaping fecal fluid.

In dealing with inflammatory appendiceal lesions which have extended from the base of the appendix down over the head of the cecum, it at times becomes difficult to close such defects so that danger of further leakage is overcome. In such cases for the patching over this area of epiploic appendages, tabs of omentum (or even a flap of postparietal peritoneum) are of great value.

The above warning as to precautions against possible spilling of liquid cecal contents applies in a like manner to those cases in which the acutely inflamed appendix has become wrapped about by the free border of the omentum, although this occurrence is more apt to appear in the acute lesions of the appendix nearer the tip of the structure.

Drainage in acute appendicitis is employed today in far fewer cases than formerly when a drain was inserted in nearly every case of acute appendicitis. One may still employ with safety the maxim, "When in doubt, drain."

It is not possible to prepare any set of indications whereby one may accurately decide for or against drainage. In general, we believe that where there is inflammatory induration extending over the cecum, where the ligature or suture of the appendix and stump is uncertain of holding, thus making possible a fecal fistula, drainage should always be instituted. When there is a definite abscess cavity, drainage should always be instituted. Where there has been definite contamination of the peritoneum locally by spilling of pus or fecal material, drainage should always be instituted.

We have in the clinic a definite rule in acute appendicitis and all other inflammatory lesions of the peritoneum, that a drain either is not removed for seven days or is not inserted at all. We strongly believe that if it is necessary to insert a drain, it should be left until it has established a good canal down to the part to be drained, and for that reason we do not remove drains

when inserted for a minimum of seven days. At that time good patent canals are established and secondary abscesses do not occur.

We are opposed to the so-called prophylactic drain left in for twenty-four to forty-eight hours. It is our opinion that when such drains can be removed without complications at this time, they did not need to be introduced originally.

A principle of value regarding drainage in acute appendectomy is that the drain, whenever possible, should be placed between the outer wall of the cecum and the lateral parietal peritoneum. It is undesirable to place drains on the inner side of the cecum because of the coils of small intestine here and the danger of producing exudative adhesions among those coils where postoperative intestinal obstruction following appendectomy for acute appendicitis is so likely to occur.

It would be unfair to close any remarks upon acute appendicitis without urging the real value, in our opinion and experience, of jejunostomy in those cases with severe and diffuse infections in and about the appendix. It is in these cases that marked postoperative distention is quite likely to occur. Temporary drainage of a high loop of jejunum in such cases, eliminating as it does one of the serious burdens to the patient in this situation, absorption of toxic high intestinal products, as well as the toxic products of the appendiceal infection, has greatly increased the chances of recovery of patients in our hands. When such a jejunostomy is carefully done with local anesthesia high on the left side of the abdomen, there is practically no shock to it. If the tube is brought out through a double thickness of omentum, there is little danger of a troublesome fistula, and many patients will be carried through a serious peritoneal situation when this step is added who would not, we feel sure, without it.

One cannot deal with the surgery of acute appendicitis without constantly gaining respect for its ever-present possibilities of serious outcome. It is a disease never to be taken lightly, and one in which a surgeon may display advantageously his greatest degree of surgical judgment and technical skill.

MATTRESSED PERITONEAL SUTURES IN EPIGASTRIC INCISIONS

HOWARD M. CLUTE

IT is well recognized that wound rupture is more likely to occur in upper abdominal incisions than in those in the lower abdomen. Hernia occurs more frequently after upper abdominal operations than after any others. In a recent statistical study of 634 gall-bladder operations in this clinic, Cattell was able personally to examine 235 patients. Of these 14 had hernias in their wounds—an incidence of approximately 6 per cent.

Such an incidence of hernia after any operation demands that one inquire closely into the methods of wound closure. It is unlikely that 6 per cent. of hernia are necessary after gall-bladder operations in spite of the occurrence of badly infected cases that drain a long time and in spite of the fact that many of these patients have postoperative cough after the upper abdominal procedure.

For many years we closed upper abdominal wounds with a continuous No. 2 plain catgut suture in the peritoneum. This suture was made to include the peritoneum and the transversalis muscle and fascia. It is true, however, that careful attention was not paid to the transversalis fascia and muscle as a layer to be carefully included in the peritoneal stitch. The rectus fascia was next closed with No. 2 chromic catgut interrupted sutures and then large sutures of silkworm gut were placed through skin, fat, and rectus fascia and tightly drawn.

We had trouble with these wounds in some cases. The peritoneal suture line of plain catgut gave way with straining and coughing. The pressure of the deep, double silkworm-gut stay sutures was very uncomfortable in many stout patients and small stitch abscesses occurred at times. Mild infections

in the fat were not uncommon and in some cases the chromic catgut knots slowly worked their way out of the wound. Furthermore, rupture of these wounds occurred in spite of the large amount of suture material employed.

Our first change in this method of wound closure was to replace all plain catgut with heavy (No. 2) chromic gut. The peritoneal suture line furthermore was made up of two or three continuous sutures rather than one long piece of catgut in order that each single piece of catgut might have less strain. The second change in the closure of these wounds was the omission of the interrupted catgut sutures in the rectus fascia. These were replaced by several continuous sutures each of which had but six or eight stitches in it. With these changes we also omitted the large stay sutures in the majority of cases. We now use large through-and-through silkworm stay sutures only where a probable infection is expected to involve all the layers of the wound, when we anticipate that the patient will have a great deal of postoperative coughing, or in the rare instance when we must hurriedly close the abdomen in an emergency without suturing each layer separately.

At this time we also began the practice of placing the drain through a small separate stab wound in all gall-bladder operations where the relations of the costal arch and the incision would permit. This is a procedure which has long been recommended and which we believe is of distinct value in the closure of gall-bladder wounds. The exclusion of the drain from the main incision gives an excellent opportunity for primary union in the place where it is most needed.

It became evident, however, that these measures were not sufficient to prevent an occasional wound rupture and postoperative hernia in certain cases. We believe that most wound hernias originate during the first few postoperative days. At this time straining causes a rupture of the peritoneal suture line and permits the escape of a wedge of omentum into the deep layers of the wound. This was shown experimentally to produce hernia every time it occurred in animals and we believe it is logical to assume that the same mechanism acts in patients.

The prevention of postoperative hernia, therefore, in our opinion becomes fundamentally dependent on the prevention of any wedge of omentum working its way through the peritoneal suture line.

It is a very significant fact that the transversalis muscle runs across the upper abdomen and that its pull is to each side from the midline. Contraction of the transversalis muscle tends to spread the peritoneal edges apart. If we are to prevent omental wedges from entering the peritoneal suture line steps must be taken to overcome the lateral pull of the transversalis muscle upon this suture line. We have been attempting this with mattress sutures through transervalis muscle and fascia as shown in the illustrations. We lay no claim to originality in this procedure and we have no doubt many other surgeons have often done the same thing. We are merely presenting it as a measure we have found valuable.

In our hands this procedure was not readily possible until we adopted spinal anesthesia for our upper abdominal as well as our lower abdominal operations. No anesthesia, that we are familiar with, permits the degree of muscular relaxation with safety that is present in properly given spinal anesthesia, and we believe it is only because of this fact that we have been able to carry out this particular method of suture. The method is so well illustrated by the pictures which accompany this article that little more than a description of the picture is necessary for its understanding.

In Fig. 502 the layers of the abdominal wall are shown which the surgeon encounters in the upper abdomen. Notice that the peritoneum is a fairly thick coat, and that it is densely adherent to the transversalis muscle. Notice that the transversalis fascia divides over the transversalis muscle in the upper abdomen and that the anterior layer and the posterior layer become fused below the level of the muscle. It is important to note in Fig. 502 that the fascia on the anterior surface of the transversalis muscle is even more prominent than shown, and we feel certain that in suturing the upper portion of the epigastric incision attention must be carefully directed to picking

up the transversalis fascia as well as the transversalis muscle when the peritoneal stitch is inserted.

We have not attempted to separate the transversalis fascia and muscle from the peritoneum and sew the peritoneum first as a single layer in the upper part of the wound and then suture the transversalis muscle afterward because we felt that the peritoneum and the transversalis were too closely adherent to permit this procedure.

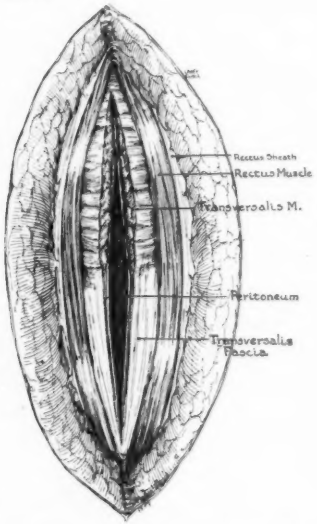


Fig. 502.—Drawing showing the various muscles and fascial layers encountered in an incision through the upper abdomen. Note the adherence of the peritoneum to the transversalis muscle. Notice the thickness of the tranversalis muscle in the upper part of the incision and the obvious strong lateral pull which it will have on the peritoneal suture line.

In the actual suture of the upper abdominal wound, then, we start at the lower angle of the wound. With the peritoneal coat clearly demonstrated with appropriate clamps we insert a continuous suture of No. 2 chromic catgut through the peritoneum and transversalis fascia. This running suture may well go up to about the point at which the transversalis muscle becomes noticeable (Fig. 503).

Figure 504 shows the completion of the continuous suture through peritoneum and transversalis fascia at the lower end of the incision and the insertion at the upper part of the wound of the first group of mattress sutures. Note that these mattress sutures are carefully placed so that they include not only the peritoneum and the transversalis muscle, but also the anterior layer of the fascia which invests the transversalis muscle. After

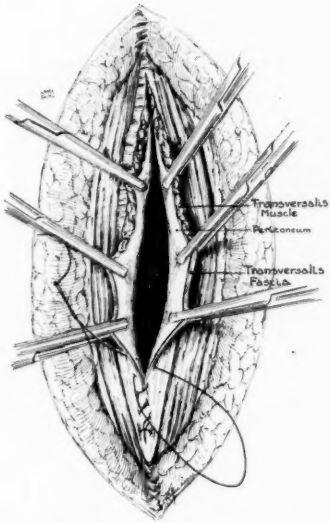


Fig. 503.—Continuous sutures inserted in the transversalis fascia and peritoneum up to the point at which the transversalis muscle becomes prominent in the incision.

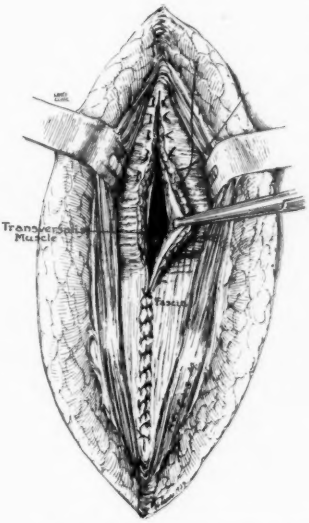


Fig. 504.—Mattress sutures are placed through the transversalis muscle, fascia and peritoneum, which shall take the strain of the transversalis pull in postoperative vomiting and moving.

the transversalis muscle, fascia, and peritoneum have been firmly united by a series of interrupted mattress sutures as shown in Fig. 504, we then insert a continuous catgut suture through the fascia to further bind this together and hold fascial edge to fascial edge. This is shown in Fig. 505.

Satisfactory suture of a wound in the upper abdomen is

dependent upon the careful approximation of each layer of tissue in order. We first insert some fine plain catgut sutures through the rectus muscle at the point of the linea transversalis. This tends to pull the bellies of the muscle together and obliterate the dead space between the rectus muscle and the transversalis fascia. The rectus fascia on the anterior surface of the rectus

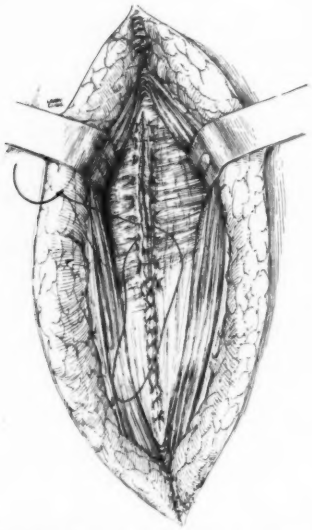


Fig. 505.—The mattress sutures have been placed throughout the length of the muscular portion of the transversalis. The continuous suture has been placed in the peritoneum and transversalis fascia at the lower end of the wound and a second continuous suture is now being inserted through the everted edges of the transversalis and peritoneum in the upper portion thus securely preventing the entrance of any omental edges between mattress sutures.

muscle is now sutured with several continuous No. 2 chromic catgut sutures. The final sutures in the wound consist of some fine plain catgut interrupted sutures in the fat to pull this together and further obliterate dead space; and lastly, interrupted silkworm-gut sutures are used in the skin.

It has been our experience in the past year that with this

method of suture we have had better wound healing than with any previous method that we have used. We, therefore, feel that we can recommend it as a satisfactory measure in the suture of upper abdominal wounds. We believe it will do much to reduce the incidence of postoperative hernia after upper abdominal operations.

SURGICAL INDICATIONS IN CANCER OF THE STOMACH

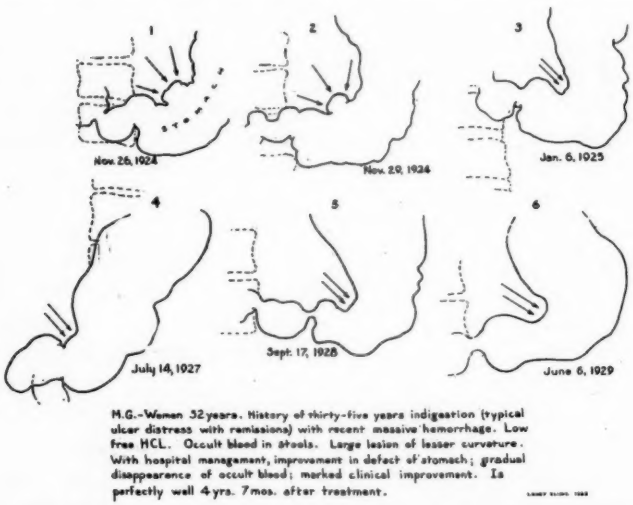
SARA M. JORDAN

IN addition to the general problem of etiology and treatment of cancer, the two important problems which present themselves in cancer of the stomach are (1) the difficulties of obtaining the earliest possible diagnosis, and (2) discrimination between the entirely inoperable cancer and the lesion which can be removed, even though with difficulty, thus affording the patient an opportunity to live with greater comfort for a longer time.

The first of these problems, the earliest possible diagnosis, was formerly usually settled by the pathologist who had an opportunity to examine every lesion diagnosed as gastric, because for a time, every gastric lesion was considered a menace to the patient's safety and was, therefore, removed. The demonstrable healing of certain gastric lesions has, however, altered the situation so that it has now become the duty of the gastro-enterologist, not only to discover the early gastric lesion, but also to distinguish, without the aid of the surgeon and pathologist, between the benign ulcer which can be healed, and the other two common varieties of gastric ulcerative lesions; namely, the unhealable benign ulcer and the early carcinoma. The first of these three types of lesions he treats medically with safety, while the second and third he refers to the surgeon for removal because of their potential or actual malignancy.

The responsibility of the internist has, therefore, increased with this diagnostic duty, new to many of them, and it may be of interest to discuss the data which are of value and of interest in the differentiation of early carcinoma, the unhealable ulcer which is potentially malignant in an organ as susceptible to malignancy as the stomach, and the healable ulcer which does not need surgery for cure. The statistics of

our clinic with regard to these three lesions, show that the early malignant lesions have, even when first seen, certain characteristics which resemble the frank and extensively malignant cases. A short history, a low or absent free hydrochloric acid, the location of the lesion in the distal third of the stomach, are data of definite significance as indicating a suspicion of malignancy. The deciding factors, however, are the results of a short period of medical management, and may be summarized as: (1) The disappearance or persistence of the ulcer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M.G.-Woman 32 years. History of thirty-five years indigestion (typical ulcer distress with remissions) with recent massive hemorrhage. Low free HCL. Occult blood in stools. Large lesion of lesser curvature. With hospital management, improvement in defect of stomach; gradual disappearance of occult blood; marked clinical improvement. Is perfectly well 4 yrs. 7 mos. after treatment.

Fig. 506.—Showing by diagrammatic outlines drawn to scale from the *x*-ray films the progress of treatment in the healable ulcer of the stomach.

niche; (2) the disappearance or persistence of occult blood in the stools; and (3) the disappearance or persistence of symptoms. Even the very early malignant case has not, in our experience, fulfilled all three conditions of disappearance of occult blood, disappearance of symptoms, and disappearance of the ulcer niche. Symptoms are often relieved; occult blood may disappear, and the radiologic defect improve to some extent, but all three conditions, including the complete disappearance of

the ulcer defect, are fulfilled only in the healable ulcer. A failure of the radiologic defect to show any definite change, alone or in association with the persistence or recurrence of occult blood or of symptoms, is sufficient evidence upon which to base a diagnosis of malignancy. An improvement in the appearance of the defect with complete relief of symptoms and disappearance

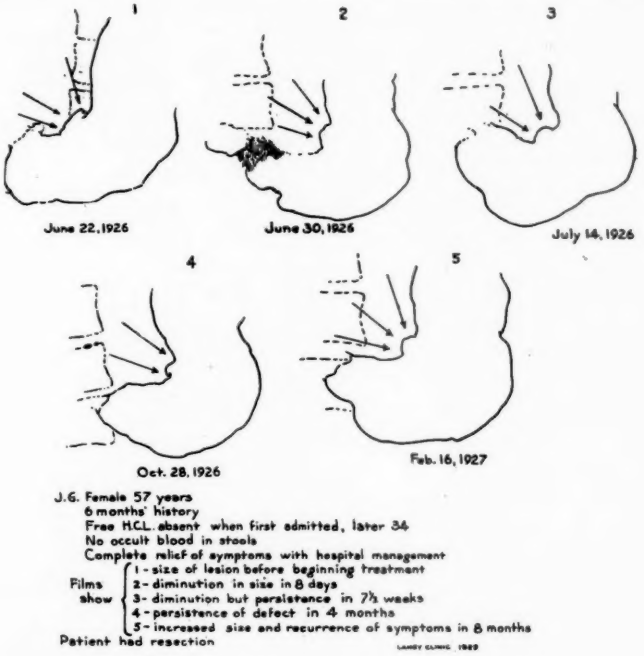
1
2
3
June 22, 1926
June 30, 1926
July 14, 1926
4
5
Oct. 28, 1926
Feb. 16, 1927
J.G. Female 57 years
6 months' history
Free H.C.L. absent when first admitted, later 34
No occult blood in stools
Complete relief of symptoms with hospital management
Films show
1 - size of lesion before beginning treatment
2 - diminution in size in 8 days
3 - diminution but persistence in 7½ weeks
4 - persistence of defect in 4 months
5 - increased size and recurrence of symptoms in 8 months
Patient had resection

Fig. 507.—Showing the course of an unhealable ulcer.

of occult blood, indicates benignity; but unless the defect can be seen to disappear completely within a reasonable period of time, the benign ulcer must be classified as unhealable and should then be resected because of the possibility of its later becoming malignant. The truly healable ulcer, on the other hand, shows with medical management, a complete disappearance of the ulcer niche and, as has been shown by palpation

and inspection upon laparotomy for other conditions, presents a soft healed scar. Figures 506–508 illustrate cases of these three types.

These three conditions represent the types of lesion which might be confused in diagnosis, and which must be watched with the greatest care in order to differentiate in their treatment, since the first two require surgery and the third is entirely cured by medical management.

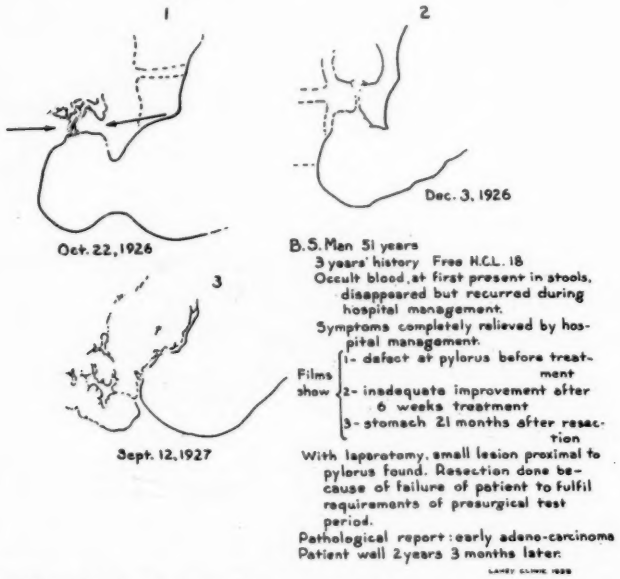
1
2
Oct. 22, 1926
Dec. 3, 1926
3
Sept. 12, 1927
B.S. Man 51 years
3 years' history Free H.C.L. 18
Occult blood, at first present in stools, disappeared but recurred during hospital management.
Symptoms completely relieved by hospital management.
Films show
1- defect at pylorus before treatment
2- inadequate improvement after 6 weeks treatment
3- stomach 21 months after resection
With laparotomy, small lesion proximal to pylorus found. Resection done because of failure of patient to fulfil requirements of presurgical test period.
Pathological report: early adeno-carcinoma
Patient well 2 years 3 months later.

Fig. 508.—Showing the course of an early malignant lesion of the stomach under trial medical management.

Another form of lesion which it is extremely desirable to detect is the very early carcinoma of the non-ulcerative type, which is just large enough to produce a very slight change in the contour and motility of the stomach. These are especially difficult to detect when they are located on the greater curvature of the stomach, in either the corporic or antral portion. It is our opinion that every patient who shows any irregularity by

either the fluoroscopic or film examination should be re-examined at intervals until all doubt has been dispelled by an absolutely normal appearance of the stomach, or until an exploratory operation has demonstrated the presence or absence of a lesion. Especially is this true if the patient has, at the same time, an achlorhydria or hypochlorhydria, and indefinite abdominal symptoms. Such a case, with the following history, has recently been seen at the clinic.

Woman, sixty-one years, admitted August, 1929.

Symptoms: Epigastric distress, loss of weight, diarrhea.

Fig. 509.—Case showing very slight irregularity of contour of greater curvature of stomach, later found to be malignant lesion.

History of having had previous study for the same symptoms in March, 1928. This study revealed a slight irregularity in the contour of the greater curvature of the stomach (Fig. 509) which was suspicious enough so that the radiologist requested another fluoroscopic examination. This, however, was considered satisfactory. An achlorhydria was also found at this time. The patient drifted from the physician who had charge of the case, and had no further examinations for one year and five months. On admission to our clinic an unmistakable radio-

logic defect of definite size and character was found in the same location as the slight irregularity observed previously (Fig. 510). Achlorhydria was still present. Laparotomy revealed a carcinoma about $1\frac{1}{2}$ inches in diameter, with metastases in the liver. It is our belief that if this patient had been kept under observation during the seventeen months intervening between the first and second studies, the persistence and development of

Fig. 510.—Case of malignant lesion of stomach seventeen months after first observation (see Fig. 509).

the slightly suspicious defect would have resulted in detection of an early carcinoma and in resection.

The question of when a frankly malignant case should be considered inoperable without exploration must, in the absence of palpable metastatic processes, be decided entirely on the basis of the extent of the radiologic defect. It has been our experience that even a very extensive involvement of the distal part of the stomach, with only a small part of the fundus free from invasion, may at times be resected with distinct advantage

to the patient. One such case, a woman of thirty-seven years, who had been refused operation elsewhere because of the extent of the lesion, and was admitted to the clinic with symptoms of complete obstruction, was successfully resected and lived comfortably for a year after resection.

Lesions of the cardiac end of the stomach, if the lesser curvature and cardia itself are involved, are obviously inoperable; but a lesion of the greater curvature of the fundus, even though it may be very high, has been found resectable.

It is no longer necessary to stress the importance of cooperation of the gastro-enterologist with the surgeon in the diagnostic and follow-up work in gastric lesions. This is just as important in gastric cancer as in gastric ulcer; first, in order to distinguish, before laparotomy, between the entirely inoperable lesion and the lesion which can be resected with advantage to the patient; and second, to make the earliest possible diagnosis of malignancy without submitting the patient with a benign lesion to unnecessary surgery.

THE EFFECT OF THE ALKALI TREATMENT OF PEPTIC ULCER UPON THE KIDNEYS

EVERETT D. KIEFER

IN the medical treatment of peptic ulcer by the widely used Sippy régime it is necessary to administer relatively large doses of alkalies over a long period. In this clinic we have found it advisable to give approximately 530 grains ($35\frac{1}{2}$ grams) of sodium bicarbonate, 170 grains ($11\frac{1}{3}$ grams) of calcium carbonate, and 20 grains ($1\frac{1}{3}$ grams) of magnesium oxid daily over a period of about one year. From this extensive use of these chemicals there has naturally arisen the question of whether or not there are untoward effects, particularly with regard to the kidneys through which the larger portion of the alkalies is excreted.

It has been our experience that patients with definitely damaged kidneys usually have an intolerance to alkalies in the amounts generally given. We have also frequently seen a transient alkalosis develop in young persons with normal kidneys. This usually occurs when the treatment is first begun and if the powders are withdrawn for a day or two they can be resumed in full dosages without further difficulty.

A large proportion of patients take the alkalies in full doses for a year with no clinical evidence of untoward effects upon the kidneys. In this clinic patients are re-examined at least every two months during the year of alkali therapy. Routine urinalysis and determinations of the blood non-protein nitrogen and the plasma carbon dioxid combining power have been done routinely. We have found that the urine is uniformly alkaline, but free from albumin, casts, and cellular elements. The non-protein nitrogen is unchanged and the carbon dioxid combining power is but slightly elevated.

Some of the chemical changes which take place in the blood of patients taking alkalies have been studied by Jordan,[1] who found that in nearly all cases there is a relatively small change in the plasma carbon dioxid combining power, plasma chlorids, and serum calcium. We believe that it is safe to conclude from the repeated checking up in this way on a considerable number of patients that there is no acute irritation of the kidneys. In order to determine if there was any chronic change in the renal function the following experiment was carried out:

In a group of 16 patients the kidney function has been estimated by means of the more commonly used clinical tests, before and after a year of treatment with the Sippy régime. In none of the 16 cases was there definite renal impairment,

TABLE I

Patient No.	Age.	Blood-pressure.	Albu-min.	Casts.	Red cells.	Range of sp. gravity.	Phthalein, per cent.	B. U. N.	N. P. N.
Before: 1	60	160/90	0	0	0	1.016–1.020	35	12	31
After:		164/86	0	0	0	1.007–1.010	6	..	39
Before: 2	53	200/100	+	0	0	1.013–1.022	58	14	24
After:		165/105	0	0	0	1.003–1.016	55	9	38
Before: 3	49	110/80	+	+	0	1.008–1.022	20	..	31
After:		120/75	+	+	+	1.012–1.020	..	..	25
Before: 4	47	130/85	+	+	0	1.017–1.028	30	9	23
After:		140/80	0	0	0	1.020–1.025	65	17	37
Before: 5	43	138/100	+	+	0	1.005–1.026	32	16	26
After:		134/64	0	0	+	1.013–1.020	65	16	38
Before: 6	22	150/90	+	0	0	1.012–1.016	42	..	30
After:		140/110	0	0	0	1.011–1.018	75	16	29
Before: 7	54	148/106	+	0	0	1.017–1.026	51	19	27
After:		150/100	0	0	0	1.007–1.012	65	14	39
Before: 8	49	130/80	0	0	0	1.014–1.026	38	15	37
After:		158/108	0	0	0	1.010–1.015	30	12	40

but the series was divided into two groups because half of the patients showed slight suggestive signs of nephritis before treatment was started. Such findings as an elevated blood-pressure, the presence of a very slight trace of albumin or a few casts in the urine, and a phthalein excretion of less than 40 per cent. were considered suggestive enough to put the patient in this group (Table I). The remaining 8 patients were considered to have perfectly normal kidneys because there were no deviations from normal in any of the tests (Table II).

An examination of the tables shows that in only 2 cases, patients Nos. 1 and 9, was there evidence of diminished renal function. However, Case No. 1 had a right nephrectomy done during the year for infected hydronephrosis secondary to bladder-

TABLE II

Patient No.	Age.	Blood-pressure.	Albumin.	Casts.	Red cells.	Range of sp. gravity.	Phthalein, per cent.	B. U. N.	N. P. N.
Before: 9	59	134/82	0	0	0	1.022–1.025	53	19	29
After:		153/106	0	0	0	1.007–1.013	29	12	
Before: 10	55	115/80	0	0	0	1.022–1.030	46	16	37
After:		.....	0	0	0	1.008–1.017	60	13	
Before: 11	51	135/75	0	0	0	1.014–1.022	40	9	38
After:		130/80	0	0	0	1.027	36	19	37
Before: 12	47	105/70	0	0	0	1 023–1.025	52	..	26
After:		118/80	0	0	0	1.005–1.017	55	14	27
Before: 13	39	150/90	0	0	0	1.006–1.022	47	..	34
After:		122/82	0	0	0	1.012–1.021	65	..	32
Before: 14	38	160/110	0	0	0	1.017–1.023	41	..	36
After:		146/104	+	0	0	1.008–1.021	70	..	31
Before: 15	31	130/80	0	0	0	1.014–1.022	58	..	27
After:		128/86	0	0	0	1.012–1.017	40	..	29
Before: 16	31	135/80	0	0	0	1.018–1.026	58	..	30
After:		130/84	0	0	0	1.016–1.030	32	16	27

neck obstruction. The change in renal function exhibited by Case No. 9 was very slight and probably can be accounted for by the age of the patient. From the results of this experiment it seems safe to conclude that within the limitations of the clinical renal function tests now in common use no untoward effects upon the kidneys of a year's alkali medication can be demonstrated.

The only relationship between alkalies and nephritis found in clinical reports is in the cases of acute toxic nephritis occurring in cases suffering from an excess of alkali and in the intolerance to alkalies which is shown by patients with previously damaged kidneys.

Gatewood[2] has discussed the untoward effects of alkalies in relation to alkalosis and nephritis. He states that 8 per cent. of the cases taking alkalies show some signs of alkalosis at some time during its administration. His experience has been that alkalosis seldom occurs in young patients without previous clinical evidence of renal disease, but is very apt to occur in patients with arteriosclerosis or with impaired renal function.

There seems to be definite evidence that when alkalosis has developed the kidneys suffer a toxic nephritis as evidenced by the appearance of albumin and casts in the urine, and by an increase of the non-protein nitrogen in the blood.

Hardt and Rivers,[3] of the Mayo Clinic, reported 6 cases of this, in 2 of which there had been evidence of nephritis before the alkali treatment was started.

A similar toxic nephritis occurs in alkalosis resulting from pyloric obstruction. Of 11 cases of this condition reported from the Mayo Clinic, all showed albumin and casts, a high blood non-protein nitrogen, and a lowered renal function. The 6 cases which came to autopsy showed either acute degenerative changes in the tubular epithelium or a diffuse nephritis. Houghton[4] and others in England have reported a similar series of findings.

Very little experimental work has been done on the question, but Addis[5] added sodium bicarbonate to the diet of rats over a long period of time and found that hematuria occurred fre-

quently in the rats taking alkali, but it also occurred occasionally in the controls. In one series the blood non-protein nitrogen was slightly elevated, and in another series it was unchanged. Another unusual result which he did not explain was the post-mortem finding of hydronephrosis in 7 of 24 rats which had been taking alkali.

MacNider[6] gave sodium carbonate solution intravenously to normal dogs and found that if the dose were not too large the alkali was well compensated in the blood and the kidneys were unaffected. However, if a larger dose was given, alkalosis occurred, signs of renal irritation appeared, and the kidney function was reduced. The injury to the kidney was in the nature of a cloudy swelling most marked in the tubular epithelium which occasionally was so marked as to be an early necrosis. Dogs which already had nephritis were found to tolerate a smaller dosage of alkali.

Conclusion.—The renal function of 16 patients with either normal or very slightly subnormal kidneys has been estimated before and after one year's treatment for peptic ulcer by the Sippy régime and found to be essentially unchanged.

BIBLIOGRAPHY

1. Jordan, Sara M.: Calcium, Chlorid, and Carbon Dioxid Content of Venous Blood in Cases of Gastroduodenal Ulcer Treated with Alkalies, Jour. Amer. Med. Assoc., 87, 1906–09, December 4, 1926.
2. Gatewood, L. C.: The Dangers and the Essential Safeguards in the Alkali Treatment of Peptic Ulcer, Illinois Med. Jour., 48, 491, December, 1925.
3. Hardt, L. L., and Rivers, Andrew B.: Toxic Manifestations Following the Alkali Treatment of Peptic Ulcer, Arch. Int. Med., 31, 171, February, 1923.
4. Houghton, L. Wynn, Venables, J. F., and Lloyd, N. L.: Nervous Symptoms due to Alkalemia and Renal Insufficiency Following Obstruction of Duodenal Ulcer, Guy's Hospital Report, 75, April, 1925.
5. Addis, T., MacKay, Eaton M., and MacKay, Lois Lachard: The Effect on the Kidney of the Long Continued Administration of Diet Containing an Excess of Acid and of Alkali, Jour. Biol. Chem., 71, 157, December, 1926.
6. MacNider, W. deB.: Studies Concerning Influence of Disturbance in the Acid-base Equilibrium of Blood on Renal Function and Pathology; Effect of Acid and Alkaline Solution on Renal Function and Pathology in Normal and Naturally Nephropathic Dogs, Jour. Metabolic Research, 3, 511 and 569, April, 1923.

ULCER OF THE LESSER CURVATURE OF THE STOMACH FOLLOWING GASTRO-ENTEROSTOMY

SARA M. JORDAN

THE solution of the problem of etiology of peptic ulcer will undoubtedly explain its recurrence under conditions which are now presumed to be therapeutic, such as neutralization of the free hydrochloric acid, and short-circuiting of the food current by gastro-enterostomy. There is no longer doubt that certain individuals have a constitutional diathesis to ulcer, and that in some of these individuals, ulcer will recur even under conditions of achlorhydria. Several examples of this have been reported in the literature, and a few have come under our observation.

The case to be described is one with persistent hyperchlorhydria and recurrent ulcer after gastro-enterostomy, and is of interest because of the previous history and the location of the ulcer after gastro-enterostomy.

Case History.—Male, forty-nine years. Admitted February, 1929. Chief complaints: Epigastric pain three to four hours after eating, relieved by soda, food, or vomiting. Loss of weight.

Previous gastro-intestinal history: Operated upon in another clinic September, 1917 after several years of typical ulcer symptoms—excision of ulcer of posterior wall of stomach. Recurrence of symptoms after four years. Re-operated at same clinic January, 1924—posterior gastro-enterostomy for duodenal ulcer. Improved, but not symptom-free, for three years. In two years before admission to Lahey Clinic, symptoms as described above under chief complaints.

This patient had a free hydrochloric acid after an Ewald test meal, of 55. Radiologic examination showed the gastro-

enterostomy stoma functioning, but there was a penetrating ulcer of the lesser curvature directly opposite the gastro-enterostomy stoma. The usual explanations for the occurrence of ulcer in or near the stoma, following gastro-enterostomy, do not apply to this case since the ulcer occurred away from the area where operative injury might have occurred to the tissues, and away from the area where the diverted food current strikes

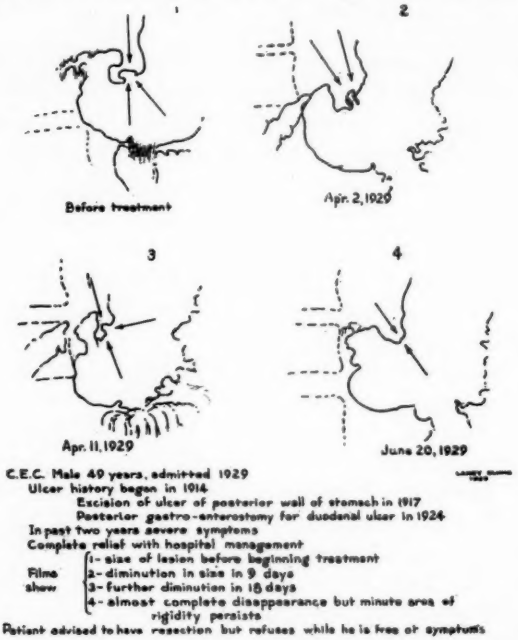
1
2
Before treatment
Apr. 2, 1929
3
4
Apr. 11, 1929
June 20, 1929
C.E.C. Male 49 years, admitted 1929
Ulcer history began in 1914
Excision of ulcer of posterior wall of stomach in 1917
Posterior gastro-enterostomy for duodenal ulcer in 1924
In past two years severe symptoms
Complete relief with hospital management
Films show
1- size of lesion before beginning treatment
2- diminution in size in 9 days
3- further diminution in 18 days
4- almost complete disappearance but minute area of rigidity persists
Patient advised to have resection but refuses while he is free of symptoms

Fig. 511.—Ulcer of lesser curvature of stomach following gastro-enterostomy.

the mucosa. It is interesting to note that in this man, in a period of about fifteen years, three distinct lesions have occurred, each apparently independent of the other, and the latter two uninfluenced by therapeutic procedures designed to heal the preceding one. It is probably logical to assume that the same basic cause underlay all three lesions, two in the stomach and one in the duodenum. Data regarding the free hydrochloric acid of

the gastric contents during the development of the first two, are not available. With the third lesion, however, in spite of gastro-enterostomy, the patient showed a high free hydrochloric acid, and during treatment it was found difficult to neutralize it. His progress under medical management is shown by the following illustration (Fig. 511), which demonstrates with diagrammatic outlines drawn to scale from the films, that the ulcer niche completely disappeared, but that a minute area of rigidity could still be made out, which in our opinion, indicates that the ulcer is not entirely healed or healable and will recur. The patient is not yet amenable to advice for resection because of his previous experience and because he is now symptom free.

TOXIC EFFECTS FOLLOWING THE ADMINISTRATION OF SODIUM TETRAIODOPHENOLPHTHALEIN (GRAHAM TEST)

HERBERT D. ADAMS

THE method of cholecystography, introduced by Graham and Cole in 1924, has proved a valuable aid in diagnosis in doubtful cases of gall-bladder disease. Since the more universal recognition of the association of gall-bladder disease to vague gastrointestinal symptoms, it has even greater value.

The two available methods of administration of the substance, sodium tetraiodophenolphthalein, by the oral and intravenous routes, present various advantages and disadvantages which have been discussed at length in the medical literature. The latter route, however, is apparently attended by the greater dangers. Oral administration has the advantage of simplicity and is less likely to be followed by a severe reaction. This method, however, we feel is far less reliable, since the hydrochloric acid in the stomach often forms an insoluble precipitate with the salt which is unabsorbed and acts as an irritant, causing considerable distress and vomiting. A check-up by the intravenous method must then be resorted to if the test is to be an aid in diagnosis. The intravenous method, while ensuring the introduction of the full amount, is more likely to be followed by a severe reaction, but this has been so infrequent that in this clinic the intravenous method is used almost exclusively because of its greater dependability.

The intravenous administration requires a very refined technic, since the slightest perivenous injection is followed by a marked tissue reaction which may progress to necrosis when larger amounts have been injected outside the vein. We have seen numerous local reactions, the most common being simple

venous thrombosis unaccompanied by tenderness or signs of inflammation. These are probably due to the irritating and sclerosing action of the dye on the endothelium. True thrombophlebitis is a less common complication, and while usually most severe at the point of injection, a few cases have shown isolated areas of thrombophlebitis at a considerable distance from the point of injection. These are difficult to explain. Where larger amounts are injected into the perivenous tissues, a sterile or chemical cellulitis develops with extensive swelling, pain, and inflammation involving the cubital space and the greater part of the arm. Sloughing at the point of injection may occur. Long periods of disability may then result and muscular contractures are apt to develop unless vigorous measures are taken to prevent them. On the other hand, we have recently seen a case in which 20 c.c. of the undiluted dye solution was injected into the perivenous tissues. There was marked swelling and inflammation of the entire arm for several weeks, but no tendency toward sloughing or contracture, and no systemic reaction. We report this incident because we feel that it is quite generally accepted that a slough is an inevitable sequence when large amounts are injected outside the vein.

Systemic reactions resulting from the intravenous administration of the dye vary greatly in severity. These range from slight disagreeable sensations to severe shock, and death has been reported. Immediate mild and transient reactions are very common and are characterized subjectively by apprehension, a feeling of oppression, warmth, and flushing, a sensation of constriction in the chest, shortness of breath, vertigo, and faintness. Objectively one observes restlessness, flushing of the skin, and dyspnea. Clinically these symptoms are so mild and transient as to be considered unimportant, but they are always significant to the patient and they come to dread further injections and treatments on account of them. During a recent period covering six months' time, Kiefer found that in 274 Graham tests given by the intravenous method in this clinic, 30 patients experienced symptoms following injection which were severe enough to be distinctly undesirable.

Very severe reactions occur infrequently and are characterized by such distressing symptoms that they leave a lasting impression on those present. Such reactions as these stimulate an ardent desire for a more careful study of the method, and a more discriminating selection of cases to which it is to be applied, in order to avoid such alarming and dangerous symptoms in the future.

One type of severe reaction is apparently associated with vasomotor disturbances and is possibly related to sensitization and anaphylactic shock. These patients present all the familiar symptoms of shock and vasomotor collapse. The following case illustrates this reaction well:

A married woman of fifty-five came in complaining of long-standing and persistent indigestion, epigastric distress, nausea, and vertigo. The physical examination was essentially negative. As a part of a routine gastro-intestinal study she was very slowly given intravenously, 3 gm. of the dye (freshly prepared in 30–40 c.c. distilled water and sterilized). She stood the procedure well and was neither apprehensive nor nervous and complained of no discomfort. Just as the injection was finished she complained of queer sensations and vertigo and suddenly became very pale and slightly cyanotic. Within a few minutes she sank into profound shock with loss of consciousness, unobtainable radial pulse or blood-pressure, imperceptible respirations, and glassy fixed eyeballs, and dilated pupils.

Artificial respiration was started at once and within a few minutes she was given $\frac{1}{2}$ c.c. of 1 : 1000 solution of epinephrin intramuscularly. After about five minutes her respirations improved and the pulse could be obtained at the wrist. She regained consciousness, but for some time afterward was very shaky and unable to talk fluently. Soon after regaining consciousness she began having very agonizing knife-like pains in the lower back, which were severe enough to make her writhe and cry out. She was given morphia, but the pain persisted for fifteen to twenty minutes. A half hour after the reaction her blood-pressure had risen to 140 mg. systolic, and she left the clinic still very trembly, pale, and sick. She spent a miser-

able night and when seen two days later she had not yet completely recovered.

Cholecystograms showed an apparently normal gall-bladder. The patient volunteered the information that she had always been very sensitive to any sort of injections and had had several less severe reactions previously.

We feel almost certain that in this type of case the most important causative factor is an idiosyncrasy on the part of the particular patient. We have ourselves seen no deaths as a result of this sort of reaction, but there has been at least one fatality of this type reported. Huddy[1] reports a case in which a woman, aged forty-six, was given intravenously 5.5 gm. of the dye in 40 c.c. triple distilled water, the injection requiring at least twenty minutes.

During the injection the patient complained of abdominal pain followed by vomiting and headache. Immediately after the completion of the injection the pain became so severe that she rolled around and screamed. The body became rigid, there was frothing at the mouth, and then loss of consciousness. The pulse and respirations became more and more feeble, the pupils dilated, and death ensued in spite of all efforts at resuscitation.

Huddy points out that contrary to his usual custom, the solution had been made up the day before it was used. Another patient injected immediately before this one and under the same circumstances had a more severe reaction than usual. We have likewise consistently noted that the incidence and severity of reactions definitely increases with the number of hours the solutions were allowed to stand before use. Huddy also feels that the amount given may have been excessive, but he quotes Cade,[2] "who, using a small maximum dose of 4.5 gm., observed in 2 consecutive cases a very similar train of symptoms." We have used even small maximum doses and have had severe reactions but no fatalities in this group.

The second type of severe reaction we feel is dependent chiefly upon a pre-existing cardiovascular disease, particularly in the presence of decompensation or coronary disease. Kiefer re-

ports a case of a woman of fifty-six with high blood-pressure and signs of beginning cardiac decompensation, who complained of marked palpitation, dyspnea, and severe abdominal pain following the intravenous injection of the dye. To this I would like to add the report of a case:

A man of sixty, with a systolic blood-pressure of 180 mm., who was admitted complaining of long-standing indigestion, epigastric distress, and more recent attacks quite characteristic of angina, with severe pain over the precordium and substernal region, radiating to the left shoulder, brought on always by exertion, relieved by rest and partially by nitroglycerin. In the course of a routine gastro-intestinal study he was slowly given 3 gm. of the dye in freshly prepared solution intravenously. Just as the injection was completed he complained of sudden severe precordial and substernal pain of very similar character to his previous anginal attacks. He began vomiting, and rapidly went into a partial collapse. He was dyspneic, cyanotic, and the radial pulse very feeble and rapid. His systolic blood-pressure fell to 100 mm. The heart sounds were of very poor quality. He was given morphia and $\frac{1}{2}$ c.c. of 1 : 1000 epinephrin solution subcutaneously and within a half hour he began to improve gradually, but was in rather poor condition for the ensuing twenty-four hours.

It is interesting to note that 2 other patients injected within an hour of this one with the same technic and with the same preparation of the dye, had not the slightest reaction.

It was felt that this patient undoubtedly had some coronary or cardiovascular disturbance of a serious nature which might well have had a much more serious outcome.

We have had 1 case of this type in which the administration of the dye was at least a contributory cause of death.

This was a woman of sixty-three, with a blood-pressure of 170 mm., who came in complaining of indigestion, gas belching, palpitation, and epigastric distress coming on immediately after meals. Eight years before admission she had had an attack of severe epigastric and substernal pain accompanied by marked prostration and cyanosis, requiring morphia for relief. She was

very much limited in activity thereafter, with palpitation, shortness of breath, and epigastric distress on exertion. During a routine gastro-intestinal study she was given the dye intravenously. That night she suffered a severe attack of epigastric and retrosternal pain accompanied by the characteristic signs of cardiac infarction. She gradually failed and died in a few days. Postmortem examination showed both recent and healed infarcts of the heart, coronary sclerosis, and thrombosis.

The close relationship of the administration of the dye to reactions of this sort in other cases makes us feel quite certain that this procedure was a factor either in precipitating or contributing to the fatal outcome of the cardiac infarction in this case. In contrast with this case there is one reported by Fitz[3] in which very characteristic symptoms of cardiac infarct developed during the administration of the dye intravenously. This diagnosis was definitely confirmed by the clinical course and electrocardiogram. The remarkable aspect of this case, however, was the fact that she not only made a good recovery, but was completely relieved from further anginoid symptoms.

The third type of severe reaction is one which occurs in the presence of liver damage or an acute process along the biliary tract. We have noted this a number of times and it has been reported by other observers. Kiefer found that gall-bladder disease was present in a large proportion of the patients in whom reactions occurred. He suggested that the dye may stir up a disease process in the biliary tract. This has been borne out clinically in a number of cases which have developed definite symptoms of acute cholecystitis within twelve hours of the injection. This has occurred twice in our experience.

Two deaths have been reported following the oral administration of the dye, one by the staff of the Christchurch Hospital, New Zealand,[4] and the other by Dick and Wallace.[5] Both showed advanced cirrhosis of the liver, hepatitis, and various stages of atrophy and necrosis at the postmortem examination. It seemed certain in both cases that the administration of the drug accelerated the course of the disease and contributed to its fatal ending. Within the past year we know of a death oc-

curring several hours following the injection of bromsulphphthalein as a liver-function test. This test is dependent upon the same physiologic processes as the Graham test. Postmortem examination showed advanced cirrhosis and liver changes in this case.

Dick and Wallace present evidence of another grave danger in the administration of this substance. They report a case of a robust miner, aged forty, admitted to the hospital on account of dyspepsia of six years' duration. A feeling of nausea followed the injection of the intravenous dye. Within three to four hours severe upper abdominal pain and vomiting occurred. This rapidly developed into an acute abdominal crisis accompanied by marked shock. The abdomen was explored and a moderate amount of free peritoneal fluid and fat necroses on the greater omentum were found. In addition, there were acute cholecystitis, cholelithiasis, stones in the ducts, and acute hemorrhagic pancreatitis. The pancreas was drained, but death followed within twenty-four hours.

Since the onset of the acute abdominal crisis appeared within a few hours after the administration of the drug, these observers hold it responsible as the cause of death, especially since the patient had been in good health immediately before its administration. They have further studied this untoward action of the drug on the pancreas, liver, and kidney by means of experimental investigations in animals. They have shown quite conclusively that in healthy animals both the ligation of the common duct before intravenous injection of the dye and also the introduction into the pancreatic ducts of normal bile drawn from the animal's gall-bladder after the intravenous injection of diagnostic doses of the drug, are sufficient to produce acute hemorrhagic pancreatitis. Controls with only common-duct ligation and the introduction of normal bile into the pancreatic ducts showed no such ill-effects. In addition, animals in which the common duct was ligated before the administration of the drug showed much more advanced degenerative changes in the liver than in normal animals receiving the same dosage. They found that in the presence of biliary obstruction the dye was

eliminated by the kidneys. However, the rate of excretion was very slow and apparently no ill-effects were sustained by these organs. From such experimental findings these observers quite properly infer that in common-duct obstruction and conditions favorable for the backflow of bile into the pancreas and stasis in the liver of bile containing the drug, the danger of the development of acute pancreatitis or hepatitis is greatly increased.

From our own clinical experiences and the experiences and experimental work of others in this respect, it appears that the use of sodium tetraiodophenolphthalein in diagnostic doses is not free from appreciable danger under certain circumstances. We have attempted to point out those conditions in which severe reactions seem apt to occur. These, in summary, are:

1. Patients subject to vasomotor instability, anaphylactic or sensitization reactions.
2. Patients with advanced cardiovascular disease.
3. Patients with hepatitis or cirrhosis.
4. Patients with signs of biliary obstruction.

The incidence of such complications and severe reactions as those described above can only be reduced to a minimum by a more careful selection of cases to which this test is to be applied and the most painstaking care in the administration of the dye. This includes careful dosage, which we feel should not exceed 3 gm.; the use of a pure and reliable preparation of the salt; careful preparation, alkalinization, and sterilization, using freshly distilled water; and the immediate administration of the warm solution very slowly by one who has had considerable experience with intravenous therapy. In case such reactions occur, vigorous measures should be taken at once to combat them according to the type of reaction present.

BIBLIOGRAPHY

1. Lancet, September, 1926, p. 509. Brit. Med. Jour., November, 1926, p. 864.
2. Lancet, July, 1926, p. 5.
3. Trans. Assoc. Amer. Physicians, 43, 292–297, 1928.
4. New Zealand Med. Jour., August, 1928, p. 230.
5. Brit. Jour. Surg., January, 1928, p. 360.

THE REPAIR OF INGUINAL HERNIA

ROBERT L. MASON

THE principles underlying the operation for inguinal hernia have remained unchanged for many years. Briefly, they provide for complete extirpation of the sac and a plastic reconstruction of the inguinal canal. Modifications of standard operations, however, have been many. Doubtless, every clinic works out certain details and modifications of the standard operations and by the test of experience determines their value. In the following notes are recorded a few details which we, in this clinic, have found to be of value.

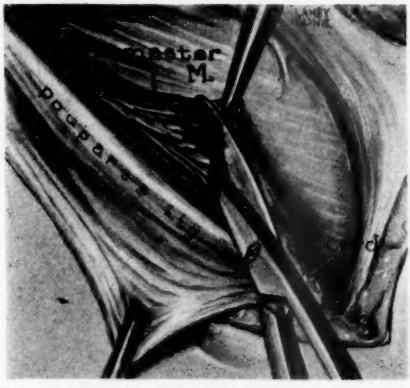

Fig. 512.—Longitudinal division of cremaster to expose sac and cord.

Exposure of the Sac.—While longitudinal division of the cremaster (Fig. 512), in order to expose the sac and to enable the cord to be mobilized, would seem an obvious step, it is surprising how infrequently this is done. The cremaster becomes an object of consideration again in the repair, and will be spoken of later.

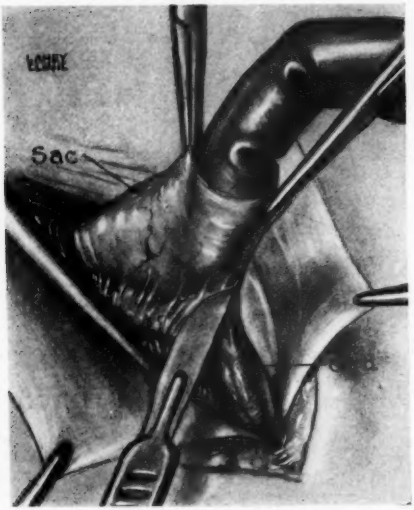

Fig. 513.—Sharp dissection of sac.

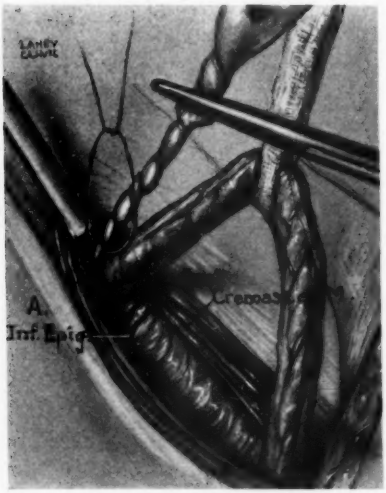

Fig. 514.—Sac twisted.

Disposal of the Sac.—The usual method of dissecting the sac has been by blunt dissection. We have found this step to be much more efficiently accomplished by sharp knife dissection (Fig. 513). It is agreed by all that high, complete removal of the sac in indirect inguinal hernia is essential to cure. By twisting the sac, as shown in Fig. 514, after it has been dis-

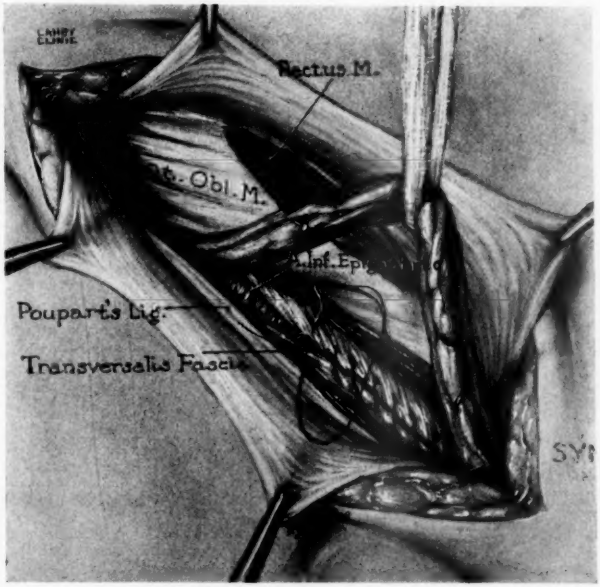

Fig. 515.—Suture of transversalis fascia. Note also incision in sheath of rectus muscle.

sected free to the uppermost portion of the internal ring, one may be certain that the sac is adequately removed, since not only is the sac completely extirpated, but a bit of the parietal peritoneum is caught up by the twisting process, thereby eliminating a potential recurrent sac.

Repair of the Canal.—We believe that closure of the transversalis fascia beneath the cord, after ligation of the sac, is a very important step in the anatomic reconstruction of the canal,

materially strengthening the posterior wall (Fig. 515). In suturing this structure one must be careful not to injure the abdominal parietes or the deep epigastric artery which lie beneath.

The cremaster, if well developed, forms a bulky mass along the posterior wall of the canal and prevents firm approximation of the overlying fascia in the repair. If large, it should be excised, especially the portion which lies adjacent to Poupart's

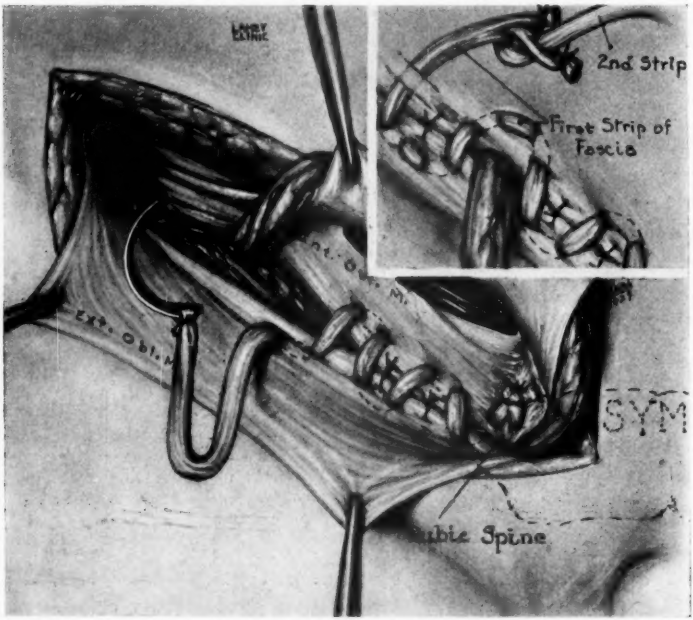

Fig. 516.—Fascial suture begun. Insert shows manner in which the suture surrounds the cord.

ligament. If small, the divided muscle may be approximated beneath the cord by a few fine interrupted sutures.

The controversy concerning the relative ultimate strength of muscle to fascia or fascia to fascia in the repair continues. If at all possible, we prefer to approximate fascia to fascia. In either case the approximation must be accomplished *without*

tension. By longitudinal incision of the rectus sheath (Fig. 515)—a procedure probably first described by Payer—fascia to fascia approximation may, in most cases, be effected and in practically all cases can be done without tension.

Living Fascial Sutures in the Repair.—The introduction of the living, fascial suture has been of the greatest value in securing firm repair of the canal. In herniæ of moderate size in young individuals whose musculature is good the method of MacArthur—utilizing a strip of fascia from one or both sheaths of the external oblique—serves admirably. In direct herniæ, recurrent herniæ, large indirect herniæ of long standing, in patients with poor musculature, and in patients who will be compelled to

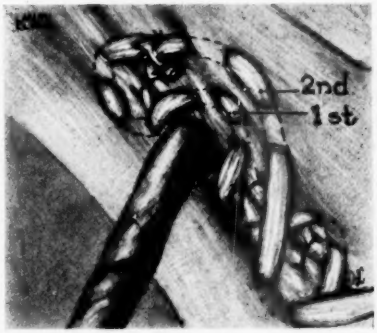

Fig. 517.—Fascial suture continued after splicing with second strip.

do heavy work following the operation, the fascia should be taken from the thigh after the method of Gallie and Le Mesurier.

Whichever method is chosen, the repair should begin at the lowermost portion of the combined conjoined tendon and rectus sheath (Fig. 516). After being anchored here it crosses to the pubic spine grasping the overlying periosteum. The suture then continued upward as in the usual Bassini repair. The fascial suture should always be reinforced, as it progresses, with interrupted chromic catgut sutures, since it is not the function of the fascial suture to hold the tissues in close approximation. Its virtue lies, rather, in its ability to grow into place, and, together

with the approximated fascia, to form a strong, non-distensible wall of tissue. It is preferable, however, to place these chromis sutures as the fascial suture proceeds, rather than to reinforce the completed chromic suture with fascia, because in the latter procedure the fascial suture cannot be placed accurately beneath the shelving border of Poupart's ligament. The fascial suture is continued upward to the point of emergence of she cord from

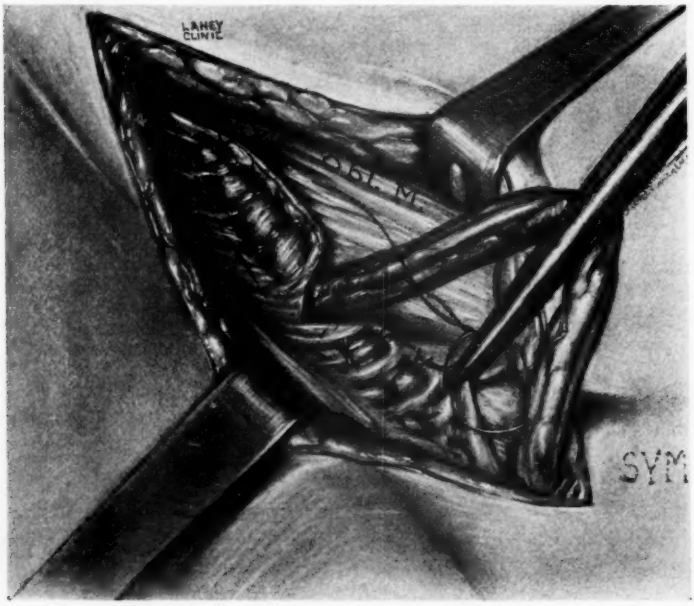

Fig. 518.—External oblique imbricated beneath cord.

the internal ring. Here, as recommended by Gallie, the suture is passed medial to the internal ring (Fig. 516).

Upon reaching Poupart's ligament the suture (after being spliced with another strip of fascia) returns around the cord (Fig. 517). In this way the internal ring is reinforced. The returning suture is interwoven with the suture already in place, as Gallie advises, and should extend well medialward with each

grasp. Here again it should be remembered that the fascia is to serve later as tissue rather than as an approximating suture.

In all but the small indirect herniæ we believe that the aponeurosis of the external oblique can best be utilized by its imbrication beneath the cord (Fig. 518) as first advised by Halstead and later by Andrews. Approximated above the cord, it can add but little strength to the repair. As a layer directly overlying the repair, especially where fascial suture has been used, it adds considerably to the strength of the repair.

THE COMPLICATIONS FOLLOWING THE INJECTION TREATMENT OF VARICOSE VEINS

RICHARD B. CATTELL

THE obliteration of varicose veins by the injection of irritating solutions is highly successful. The immediate results have been uniformly good in many hands in spite of the fact that different solutions have been used. In view of these many successful recent reports of this treatment the author would like to sound a warning to those unfamiliar with the actual injection. One might surmise from reading most of these papers that there is relatively little danger or discomfort to be encountered. With regard to mortality following injections this enthusiasm is warranted, for the reported deaths following this treatment are very rare and certainly below the postoperative mortality figure.

The occurrence of minor complications, however, are by no means rare, and will, we feel sure, be encountered by most in beginning the use of this method. The simplicity of the method fails to impress one that serious complications may arise.

This paper is written to present the occurrence of difficulties and complications that occurred in the author's experience in order to lessen the occurrence of complications for those who are contemplating or have begun the injection treatment.

We have had no deaths from any cause following injections and we wish only to mention this possibility. McPheeters and Rice[1] analyzed the reported deaths. In reviewing these deaths the most important contributing factor in deaths following injection is infection. Infection may be present at the time of injection or may occur at the site of a faulty injection. Where phlebitis or other cutaneous infections are present, obviously the patients should not have been injected. Secondary infec-

[1] Jour. Amer. Med. Assoc., 91, 1090, 1928.

tion occurring at injection sites outside of the vein wall can be reduced to a minimum by great care and increasing experience.

The complications that occur with the injection treatment must be constantly kept in mind. They may be divided into local and general effects as follows:

1. Immediate local reaction.
2. Immediate general reaction.
3. Latent general reaction.
4. Latent local reaction.
   (*a*) Marked inflammation.
   (*b*) Ascending perivenitis.
   (*c*) Sloughs and ulcers.

1. The **immediate local reaction** is rarely of serious importance. This consists of a burning sensation at the injection site and in the approximate vein. At times it becomes a severe cramp with pain radiating through the calf and over the extensor or plantar surface of the foot. The distribution of the pain seems to indicate nerve stimulation since it does not follow the course of the veins. These cramps are most frequent after the salicylate or saline solutions are used, while the burning sensation more often comes with the use of the quinine solution. Although such discomfort may trouble the patient considerably it rarely continues for more than one to three minutes. Such a local response can be expected frequently after an injection correctly done, and one must judge its severity in order to distinguish the more severe symptoms that follow injection outside of the vein. It should be said that the pain accompanying injection is rarely severe enough to cause the patient to discontinue injections, although this has occurred three times in our experience in very nervous women.

2. The **immediate general reaction** depends largely on the temperament of the patient as well as on the solution used. The majority of our patients at the time of the first treatment showed a general disturbance. This may be evidenced by thirst, sweating, faintness, anxiety, vertigo, palpitation, tinnitus, and fainting. There is probably a very prominent emotional factor as evidenced by the fact that later injections with a larger quan-

tity of solution can be used on subsequent visits without a general effect being noticed by the patient. It is unwise to attribute all the reactions to an emotional factor because certain of these symptoms should be a warning to stop further injections at that visit. Probably an individual sensitivity to the strong solutions, particularly quinine, play a part in this reaction. We have noticed thirst and a salty taste after the injection of large amounts of 20 to 30 per cent. saline solution, which indicate that a large quantity has passed beyond the stagnant area of the veins into the general circulation. Even with 2- to 6-c.c. injections of quinine and urethane, toxic symptoms from quinine may be noticed —such as tinnitus, feeling of fulness in the ears and head, palpitation, vertigo, nausea, and lower abdominal pain from uterine contractions. This is an indication to use small quantities. Three patients have complained of uterine cramps which lasted for thirty minutes or more. O'Neil[1] reported an abortion in a case injected with quinine where early pregnancy had not been discovered. One of our patients menstruated for one and a half days after each of four treatments during one month in which quinine was used in amounts of 2, 3, 4, and 3 c.c. The faintness and sweating are more apt to be nervous in origin. We were very early impressed with the necessity of watching for these immediate general effects. One of our first patients, whom we were injecting, standing on a chair to facilitate injection, became faint and would have fallen to the floor if the faintness had not been quickly noticed. The faintness may come on suddenly with little warning, and for this reason all patients are injected either on or beside an examining table, where they may lie down quickly if necessary. In this way fainting can be prevented when the head is placed down at the first symptoms. We have had no immediate general symptoms that were alarming after the use of saline solution even with large amounts. On a few occasions we have been worried over the general disturbance after quinine.[2] Rarely it has been necessary to keep patients in

[1] New England Jour. Med., 200, 972, 1929.

[2] Quinine hydrochlorid, 2
Urethane, 4
Aqua dist., 30

the office as long as two hours after injection of 4 to 6 c.c. of this solution before the symptoms are relieved. These patients should be sent home with a companion.

One patient had a very severe reaction. She was an American woman, fifty-seven years of age, of a placid temperament. She had an active varicose ulcer and varicosities on both legs. She stated that she had had rare attacks of dyspnea and palpitation. At her second visit 6 c.c. of the quinine solution were injected. As the injections were completed she began to perspire freely and had marked dyspnea. In a few moments she felt unable to get her breath lying down. She became pale and dizzy, with marked apprehension, and was mentally confused. Her pulse was weak, but the rate was below 100. The mental confusion lasted only a few minutes and she was able to return home an hour later. She has been treated subsequently with smaller doses without reaction. This is an instance of overdosage of the drug, and must be avoided.

3. **Latent General Reaction.**—There has been little or no mention made of possible latent general or constitutional reactions after injections, but we should like to call particular attention to these, since it may defeat the aim of keeping these patients ambulatory and at work. We have had patients report that on the evening of injection they were unable to eat their evening meal, and were nauseated for twenty-four to thirty-six hours. Rarely vomiting occurs during this period. Headache and general malaise with a feeling of fatigue and lassitude may occur. These general symptoms are no doubt due to too large quantities of the solution being used, but they can be expected at times with the usual small amounts, and their presence should be ascertained before the next treatment is begun. We have had these late general effects in 2 patients after the majority of their treatments—one receiving the quinine and the other the saline solution.

4. **Latent Local Reaction.**—*Marked Inflammation.*—(*a*) There is frequently a noticeable reaction in the region of a vein that has been correctly injected that may be evidenced by a firm, slightly red, swollen, and tender area. Such inflammation will subside

within two or three days. At times, however, a marked inflammatory reaction takes place causing considerable discomfort and may temporarily keep the patient from work. We believe that such an occurrence is practically always due to a faulty injection, and usually due to placing the solution outside of the vein. While it is possible that leakage may occur through the needle puncture and cause this trouble, it would seem very improbable if pressure is kept over the injection site for a period of one or two minutes, as should be done. Certainly the fact that one withdraws blood into the syringe is no indication that the point of the needle remains in the lumen of the vein throughout the injection. At times injection of a very large thin-walled vein will lead to an extensive inflammation about it with marked swelling, redness, and tenderness, but it can be noted that this extends in a general way along the vein and not in a diffuse area at the injection site. Supportive treatment is indicated if a marked inflammation develops. The patient should be kept at rest wearing firm elastic bandages constantly and cold should be applied locally.

The reaction will usually subside in a week or less, and during this time injections should be discontinued.

(*b*) *Ascending Perivenitis.*—The local inflammatory reaction may rarely involve all of the internal saphenous in the thigh even though the injection be confined to a point near the level of the knee. Such an ascending chemical phlebitis may be very alarming. This has occurred in a saphenous vein that was not dilated to palpation as well as in the greatly dilated and tortuous ones. Although it results in complete obliteration of this vein which is very important for complete relief, no serious trouble has followed. The possibility of the extension of the thrombosis into the femoral and iliac veins must be considered. The anatomic arrangement of the fossa ovale, the stagnation in the varicose superficial venous system, and the large volume of moving blood in the femoral veins probably guard against this possibility. Rest and local treatment are indicated and a considerable period should elapse before injections are continued.

(*c*) *Sloughs and Ulcers.*—Any appreciable amount of the

saline, quinine, or salicylate solution injected outside of the veins will cause a slough which leads to a chronic ulcer. Certainly ulceration following injection is proof that the solution has been perivenous. Slough follows an intracutaneous injection, but this is very unlikely unless one attempts to obliterate the very small superficial veins of a telangiectatic character. If the local symptoms of burning, cramps, and pain persist for more than three minutes then a perivenous injection should be suspected. It will usually show locally a rapid swelling of the area, particularly after the use of concentrated salt solution.

An ulcer can be prevented by the injection of normal saline or distilled water. This will increase the swelling and local pain, but should be done where any doubt exists. These sloughs begin with a marked local inflammatory reaction and develop into deep, punched-out areas with steep sides and a very adherent black center. This is a local dry gangrene producing an injection ulcer. They should be carefully kept clean with a sterile pad to guard against infection. They require weeks and at times months to granulate and heal.

Injections can be continued after the acute inflammatory reaction subsides. It is probably unwise to attempt excision of these ulcers because healing in the area is slow and healing by primary union is uncertain. Fortunately, this type of ulcer is small—about 1 cm. in diameter—and it causes little inconvenience after the acute state. We have had thirteen injection ulcers in 7 patients in the first group of 60 patients that we injected. This occurred in a total of *1115* injections. *Twelve* occurred after the use of saline and *one* after the quinine solution.

Every one who contemplates the injection of veins should recognize the possibility of the occurrence of injection ulcers, particularly early in their experience. In order to avoid possible later trouble we feel it is wise to tell each patient of this possibility.

In conclusion, we do not wish to discourage the use of this very valuable treatment, which we consider as the treatment of choice for varicose veins. We feel that the minor complications following injections have not been sufficiently stressed or appre-

ciated. We hope that their occurrence may be lessened by stating our own experience with these complications. Our experience has been confined to the use of 20 to 30 per cent. saline and quinine hydrochloride-urethane solutions. In order to lessen the general or constitutional effects that may occur with these solutions, we recommend that 5 to 20 c.c. amounts of the saline solution be used in each vein with an average of 10 c.c. for the usual dilated varix. The total amount at each visit should not exceed 50 to 60 c.c. In order to avoid the toxic symptoms of quinine $\frac{1}{2}$ to 2 c.c. amounts should be used in each vein, and the total should not exceed 6 c.c. The local reactions will be avoided by exercising great care in making the injections, and will be reduced to a minimum as one's experience increases. It is wise to discuss certain possible complications of this treatment with each patient, particularly the occurrence of injection ulcers and inflammations. The possible unfavorable impression the patient may have will be more than balanced by the assurance that the veins can be completely obliterated by means of injections.

LEFT CAROTID JUGULAR ARTERIOVENOUS COMMUNICATION

WALTER B. HOOVER

OUR recent observation of a case of arteriovenous communication without obvious etiology and in which only one symptom occurred—a constant murmur in the neck—was so unusual that we consider its presentation worth while.

Since the description of arteriovenous communication as a clinical entity by William Hunter[1] in the year 1759 many cases have been recorded. Callender[2] collected 447 cases from the literature in 1920, of which 32 were of the common carotid and jugular, 10 of the internal carotid and internal jugular, and 9 of the external carotid and external jugular or other veins; *i. e.*, 51 cases in all where one of the carotid arteries and veins in the neck were involved. Of these cases 46 were caused by trauma, the most common of which was injury from gunshot wounds and sword wounds. Pathologic processes of the arterial walls eroding the vein, as in an arterial aneurysm, have been responsible for a few cases. According to Bevan[3] the lesion may be congenital. This view is also held by Halstead[4] and others (Callender and Reid[9]).

The symptoms and signs of arteriovenous communication are those of dilated ond tortuous blood-vessels. A tumor is usually present, but the most constant finding is a continuous murmur, accentuated with systole and a palpable thrill, which may be controlled by a central compression of the artery. Secondary symptoms and signs due to circulatory disturbance may result and thus edema and cyanosis are frequently found. These, in turn, may be accompanied by numbness, tingling, pain, and even paresis due to pressure on a nerve and fatigue of a portion, due to the poor blood-supply. In case the carotid artery is in-

volved, cerebral symptoms may result from cerebral anemia, and if the vessels inside the cranium are affected, direct pressure symptoms like those of a brain tumor may result (Dandy[5]). L. A. Stimpson[6] noted that in arteriovenous communication of the carotid and jugular dilatations of the veins are less probable, due to the very large veins and the low or negative pressure in the chest which aspirates any excess of blood and prevents resulting pressure or distention of the veins.

The heart becomes hypertrophied and dilated when a large quantity of blood is projected into the veins from an arterial opening and carried back to the heart. In such cases myocardial failure may result. These symptoms are stressed by Reid, Halstead, L. Sencert, Callender, and others, and is an important consideration for surgical intervention.

In arteriovenous communication of the vessels of the head and neck the patient may be greatly annoyed by the murmur, and this is especially true of the carotid-jugular lesions. In Hunter's[1] second case the lesion was in the arm and sleep was disturbed if the arm was held close to the head. Ferris-Smith[7] report a case in which deafness resulted from a congenital arteriovenous fistula in the tympanic cavity. A pounding noise had been present since the patient's earliest recollection and spontaneous hemorrhage occurred at the age of twenty-four.

The course of arteriovenous communication is usually gradually progressive, but is much slower than that of arterial aneurysms. Years may pass without appreciable change in the size of the tumor; however it may progress rather rapidly and lead to death. On the other hand, L. Sencert[8] cites 2 cases shown by Gozzi and Routin before the Société de Chirurgie, who six months previously had presented all the signs of an arteriovenous aneurysm in the neck. The sole treatment was rest, yet the tumor with all its manifestations, thrill, expansion, and murmur had completely disappeared.

Where the symptoms warrant surgical intervention the object to be obtained is the complete and permanent separation of the arterial and venous currents of blood and the obliteration of their anastomoses. The ideal method is that of removal of the

intermediate connection and repair of the vessels by suture. Due to the nature of these lesions this is very frequently impossible, since larger portions of the vessels may be removed than could be brought together by suture. Ligation then becomes necessary and it may be necessary to ligate the artery above and below, as well as the veins. In cases where more than one artery and vein are involved it may be necessary to extirpate the sac, ligating all vessels entering into it. If it is feared that the collateral circulation is inadequate, the arterial defect may be overcome by inserting a venous graft. Review of the carotid cases collected by Callender shows that in the treatment of 16 cases* of carotid-jugular communication in which ligations of the common carotid were done, two resulted in death and one of the two had a hemiplegia for six days. A cure resulted in the remaining 14. In one case where the internal carotid was ligated, weakness of the right side resulted and there was a residual cavernous sinus thrombosis. Another case of internal carotid ligature resulted in cure. Two cases of ligation of the external, internal, and common carotid resulted in cures and one case of ligation of the external and common carotid resulted in cure.

Report of a Case.—*History.*—Mrs. V. Y., aged thirty-eight, was referred to the clinic by Dr. E. H. Hoffman April 15, 1929. Her complaint was of a constant noise in the left ear. The onset of her symptoms was not definite, but began about one year previously. In June, 1928 a cholecystectomy was done for attacks of acute pain in the right upper quadrant. Following this operation her abdominal symptoms were relieved, but she believed the noise in the ear had become more noticeable and had increased up to the present time. It was now very distressing, as she has been kept from sleep. The patient had discovered that by pressing on the side of the neck the murmur could be stopped as long as pressure was maintained. In the past month she had been unable to sleep except with pressure applied to the neck, and this she had accomplished by wrapping a large marble in cotton, affixing it to a board, and fitting it to the neck. She would then lie on the left side so that the weight of the head and

* These cases are listed in Callender's table.

neck gave sufficient pressure against the device to control the noise. The patient asserted that she had done this every night for a month. She also had noticed some numbness and tingling of the face and neck on the left side.

The examination showed an obese woman in apparently good health. The pulse was 67 to 70, and the blood-pressure was 110/70 and equal in both arms. Dr. Hurxthal found no enlargement nor dilatation of the heart. Examination of the ears was negative and hearing was normal if pressure was applied to the left side of the neck; otherwise, the effect of a noise apparatus was present. On examination of the neck, thorax, chest and arms, no dilated vessels nor tumor could be seen nor felt and no thrill could be detected. The murmur complained of could be heard a foot away from the patient. With a stethoscope a loud purring noise—loudest in systole—could be heard over the neck and left side of the head. It was best heard, however, over the region of the bifurcation of the common carotid up to and over the ear. It was not heard below the clavicle or in the axilla. The noise was easily controlled by pressure anywhere along the carotid from $1\frac{1}{2}$ inches above the clavicle to the angle of the jaw. It could be controlled, but it was much more difficult to do it, by more firm pressure above and below these points. The blood, blood Wassermann, and urine were all negative. A diagnosis of carotid-jugular arteriovenous communication was made.

Operation (By Dr. Lahey, Dr. Hoover on April 22, 1929).—Under local anesthesia (cervical block) an incision was made 8 cm. long, anterior to the sternomastoid muscle and below the angle of the jaw. The dissection was carried down, exposing the bifurcation of the common carotid artery over an area of about 2 cm. above and 4 cm. below it. Nothing abnormal was encountered in the dissection. The external carotid was isolated and compressed without an appreciable change in the murmur. The common carotid was then compressed and the murmur became of a higher pitch, but was still present. This change in pitch was noticeable both to the patient and to the observer who had a stethoscope on the patient's ear. The internal jugu-

lar was then compressed and the murmur was completely controlled. The vein was ligated with two catgut ligatures and one of silk placed between. There was the usual ballooning of the vein above the point of ligation, while below it the vein was collapsed. The wound was closed and the postoperative course was uneventful. At present over four months later, there has been no recurrence of the noise nor has any symptom developed suggestive of arteriovenous communication.

Discussion.—While a communication has not been demonstrated, we believe the operative finding indicates that such a communication exists proximal to our operative field. The patient has been relieved of her symptoms, yet no occlusion of a communication has been made. The vibration of the vessel and column of the blood in the vein has been stopped. Unless other symptoms develop, exploration of the lower portion and root of the neck is not justified.

BIBLIOGRAPHY

1. Hunter, William, cited by Callender, C. L.: Bull. Johns Hopkins Hospital Reports, vol. 19, p. 260, 1920.
2. Callender, C. L.: Bull. Johns Hopkins Hospital Reports (same as above).
3. Quoted from Tillman, Lexter Bevan, New York, 1908.
4. Halstead, W. S.: Surgical Papers, Baltimore, Johns Hopkins Press, 1918, vol. 1, p. 476.
5. Dandy, W. E.: Arch. of Surg., A-V Aneurysms of the Brain, August, 1928, vol. 12, p. 190.
6. Stimpson, L. A.: Case of Arteriovenous Aneurysm of the Left Common Carotid and Internal Jugular Vein, etc., New York Med. Jour., 1888, xlvii, p. 214.
7. Ferris-Smith: Congenital Arteriovenous Fistula in the Tympanum, Arch. of Otolaryngology, July, 1929, vol. 10, p. 32.
8. Sencert, L.: Wounds of the Vessels, University of London Press, Ltd., 1918, p. 129.
9. Reid, M. R.: Studies on Abnormal Arteriovenous Communication, Acquired and Congenital. Series of Papers in Archives Surg., vol. 10, p. 601, March, 1925; vol. 10, p. 996, May, 1925; vol. 11, p. 237, August, 1925.

SUCTION REMOVAL OF CAUTERY SMOKE

HOWARD M. CLUTE

THE use of the actual cautery, either electric cautery or fulguration with the high-frequency spark, in the operating room is accompanied by certain undesirable features. First

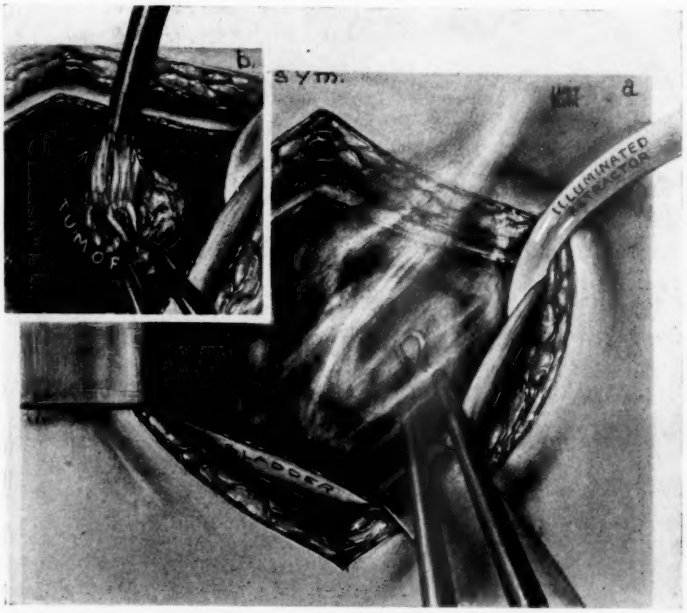

Fig. 519.—Suction tube used to clear bladder of cautery smoke.

the odor of burning flesh is very objectionable to patients in whom local anesthesia is advisable and second, even when the odor is not noticeable, there is always the difficulty of having the field obscured by the smoke which arises from the cautery.

When the cauterization is performed inside of one of the body cavities, such as the mouth, bladder, or rectum, the smoke collecting in the field may interfere with the surgeon's view. These difficulties can be overcome by the adequate use of suction, while the cauterization is taking place.

In the accompanying drawing (Fig. 519) made at an operation, the surgeon is using the actual cautery to destroy a large papillomatous tumor of the bladder. He observed in this instance that every time the cautery was applied to the tumor the bladder filled with dense smoke; this made it impossible to see the extent or the depth to which the cauterization was being carried out. Suction apparatus was employed in the field and the point of the suction apparatus was placed near the site of cauterization. It was found with this apparatus that the smoke from the cautery was taken up by the suction and did not obscure the field. In addition, the usual objectionable odor was absent.

We have used this method with fulguration and with actual cautery when applied to tumors inside the mouth, to tumors inside the bladder, and to hemorrhoids. In these instances it has proved satisfactory and is of distinct benefit in the use of the cautery in our experience.

AVULSION OF TIBIAL TUBERCLE: REPAIR BY FASCIAL TRANSPLANT

ROBERT L. MASON

WHILE partial separation of the tibial tubercle in childhood (Osgood-Schlatter disease) is not infrequent, complete, traumatic avulsion of the tibial tubercle is not common. Wilson,[1] in reviewing the records of the Massachusetts General Hospital, found that of the admissions to the Fracture Service during the past ten years, there had been but 2 cases of complete avulsion of the tibial tubercle.

When complete avulsion of the tibial tubercle occurs, it is the result of violent contraction of the quadriceps. The symptoms simulate those of fracture of the patella. The avulsed tubercle is pulled upward and a pronounced defect can be felt in the usual position of the inferior portion of the quadriceps tendon. Extension of the knee is impossible, since with the avulsion, the lateral expansions of the quadriceps tendon are torn away.

Case Report.—The patient, a man of sixty, slipped and fell while at work carrying mail. He fell with considerable force, bending his left leg beneath him. He was unable to arise and could not extend the lower leg. Examination showed the left knee to be slightly swollen. The patella was retracted upward and was freely movable. In the region of the tibial tubercle was a definite defect. *x*-Ray examination showed complete avulsion of the tibial tubercle upward (Fig. 522). *x*-Ray of the opposite knee showed no evidence of partial separation of the tibial tubercle.

Operation.—Dr. R. L. Mason. Ether anesthesia. Incision over crest of tibia, beginning just below the level of tibial tubercle and extending upward for about 10 cm. Considerable

blood-clot evacuated and the wound washed with saline. The tibial tubercle was seen to have been torn cleanly off, and was retracted upward by the patellar tendon for about 2 inches, the lateral extension of the quadriceps having been torn away.

Repair by fascial transplantation as described by Allen[2] was decided upon. With a 4-mm. drill, connecting holes were drilled in the upper end of the tibia, beneath the site of the avulsed tubercle (Fig. 520, *a*). The upper drill hole was started about ½ cm. from the upper end of the aperture left by avulsion of the

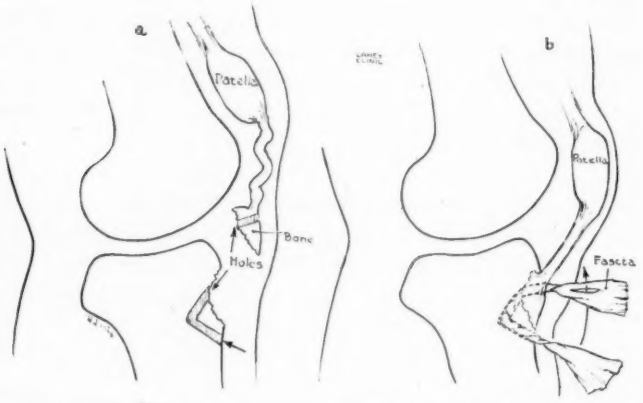

Fig. 520.—*a*, Drill holes for passage of fascia. *b*, Fascia drawn through. Upper end of fascia has been unrolled and fenestrated.

tubercle and was directed obliquely. The channel was completed by drilling obliquely from the crest of the tibia below the tubercle, until the first drill track was entered. The avulsed tubercle, attached to the patellar tendon was now drilled in the midline, at its upper third (Fig. 520, *a*). A strip of fascia lata 1.5 cm. in width was then taken from the left thigh, and rolled compactly. The rolled ends were tied with silk, left long on one end. This end was threaded through the open end of a flexible silver probe, which was made to traverse the opening in the tubercle and the channel in the tibia. The fascial strip was easily

made to follow (Fig. 520, *b*). The upper end of the fascial strip was then spread out and fenestrated. The lower end was brought through this opening, spread out, and anchored in place well up on the patellar tendon by No. 2 chromic catgut (Fig. 521). The lower end was drawn taut and anchored in place to the fascia overlying the tibia (Fig. 521). The lateral extensions of the quadriceps tendon, which had been torn, were then sutured with interrupted chromic catgut sutures, and the wound closed.

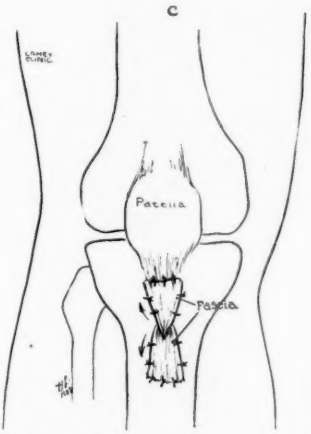

Fig. 521.—Diagram of knee-joint to show fascial strip in place over avulsed tibial tubercle.

The leg was immobilized in a light plaster bandage extending from toes to groin.

The patient made a splendid operative recovery. On the fifth day gentle, active motion was begun and increased daily. He left the hospital on the seventeenth postoperative day. He was then able to flex the knee to 60 degrees. Short periods of weight-bearing were allowed at the end of the sixth week, increasing daily. By the end of the ninth week, he was able to flex the knee fully. When last seen, four months after the operation, he had resumed his work as a letter carrier and was having no difficulties.

The method of using living suture grafts in the repair is that described by Allen,[2] and used by him in the repair of a variety of fractures and dislocations. Osgood and Bucholz[3] have shown that, when passed through drill holes in bone, tendons become firmly attached to the bone to form a solid living fragment. Allen believes it is probable that fascial strips act similarly.

The technic is described in the operative note and shown in the illustrations. Care should be taken to have the fascial strip

Fig. 522.—Avulsed tibial tubercle.

free from fat. It is essential that the strip be rolled compactly. The strip thus rolled is easily drawn through the drill hole, following the lead of a flexible silver probe to which the fascia has been attached by a strand of strong silk (Allen). The upper end is then fenestrated by a longitudinal slit, the lower end brought through, spread out over the infrapatellar tendon, and sutured in place by No. 2 chromic catgut. The opposite end is similarly spread out and sutured to the fascia of the lower leg below.

In this case active motion was not instituted until the fifth day, but owing to the strength of the suture, it is quite probable that active motion could be started much earlier without jeopardizing the repair.

BIBLIOGRAPHY

1. Wilson: Personal communication.
2. Allen: Arch. of Surgery, 1928, vol. xvi, p. 1007.
3. Osgood and Bucholz: Quoted by Allen.

RUPTURE OF THE QUADRICEPS TENDON

ROBERT L. MASON

RUPTURE of the quadriceps tendon is a much more common injury than that described above, and is well known. The following case is reported to illustrate the further usefulness of fascia lata in the repair of injuries of this kind.

Case Report.—The patient was a short, heavily built man of sixty-two. One hour before being seen in consultation, he

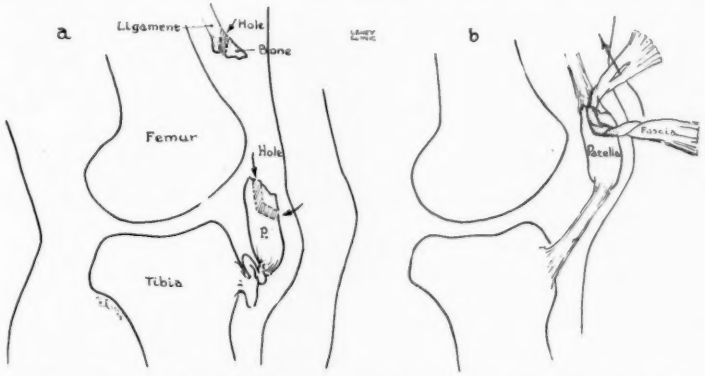

Fig. 523.—*a*, Ruptured quadriceps tendon. Drill holes through patella and portion of bone torn from upper end of patella. *b*, Fascial strip drawn through.

had dodged an automobile, and in doing so he turned sharply on his right foot. He experienced immediate agonizing pain just above the knee. He was forced to sit down, and found that he was unable to extend his lower leg.

Examination showed the patella unusually mobile, with a definite defect in the usual attachment of the quadriceps tendon. On attempting to extend his leg, a firm, rubber-like mass could be felt a hand's breadth above the patella.

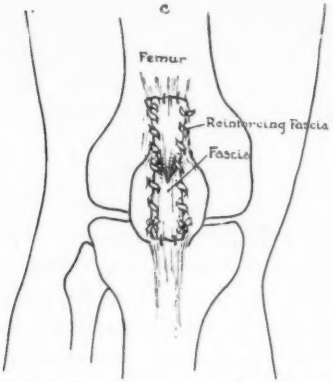

Fig. 524.—Fascial strip sutured in place and reinforced by fascial suture.

Fig. 525.—Ruptured quadriceps tendon. Note fragment of patella retracted upward.

A diagnosis of ruptured quadriceps tendon was made and operation advised. *x*-Ray (Fig. 525) showed a small portion of bone about 2 inches above the patella; obviously a small portion of the patella torn off by the tendon.

Operation (June 22, 1928).—Midpatellar incision (right). Incision carried down to quadriceps tendon and patella. The patellar tendon was found retracted upward for a disance of 2 inches. There was a small piece of bone attached to the lower surface of the retracted quadriceps tendon. The patella was retracted downward and a moderate amount of blood-clot lay beneath the patella and the ruptured tendon. The lateral capsule of the joint was torn on the right side. The muscle on the medial side was considerably torn. After clearly exposing the bony surface of the patella for a short distance a drill hole 3 mm. in diameter was bored in the long axis of the patella at its midportion. Another drill hole connecting with this was made from the upper side of the patella. A malleable probe could readily be passed through these communicating openings. An incision was then made on the lateral surface of the right thigh and a strip of fascia $\frac{3}{4}$ inch wide and 10 inches long was removed. This was led through the opening in the patella by means of the malleable probe. The lower portion of the wide piece of fascia was then brought through a small opening in the upper portion in such a way as to tightly include the patella. The fascia was then spread out to its full width and sutured in place to the tendon above and the patella below. Four strips of fascia $\frac{1}{4}$ inch wide were then cut from the side of the thigh and interwoven between the quadriceps tendon and the patella below, reinforcing the wide strip of fascia. The tendon and lateral capsule of the joint were sutured with chromic catgut. The outer capsule of the joint was closed with fine, chromic catgut sutures. Incision on the lateral surface of the thigh was closed with silkworm gut. A light plaster cast was then applied from toes to groin.

Postoperative Course.—Gentle active motion was started forty-eight hours after the operation and increased daily. Restricted weight-bearing was allowed at six weeks. After eight weeks he was allowed full use of the leg and at that time could flex the knee well over 90 degrees. He recently reported, through his family physician, that he had had no further trouble with the knee.

FUSED SUPERNUMERARY KIDNEY

JAMES B. HICKS

FUSED supernumerary kidney is one of the most common anomalies of the urinary tract and there are numerous reports of the condition in the literature. In the last 218 successive pyelograms, at this clinic, 7 instances of the condition have been found. These illustrate the various types of duplication, as well as certain features in the diagnosis and treatment.

Fused supernumerary kidney usually occurs with duplication of the ureter and pelvis on one side with a normal kidney on the opposite side. The anomaly is more often unilateral, but a few cases of bilateral duplication have been reported. The kidney is, as a rule, considerably elongated and may or may not show a distinct sulcus which divides it into two parts.

The pelves of the duplicated kidney are generally of unequal size. The upper one is practically always rudimentary in type with a larger and more normal appearing lower division. Braasch has found that the function of the two pelves is equal in amount even though they are unequal in size. The total function of the two has been found to equal that of the single one on the opposite side.

The ureters from a supernumerary kidney may join at any level between the kidney and the bladder, or they may pursue an entirely separate course and have separate orifices in the bladder. When the ureters are completely duplicated, the one from the upper division enters the bladder at a lower level.

Fused supernumerary kidney is of clinical importance because in practically every instance the patient develops some disorder in one or both divisions of the kidney. These kidneys are prone to infection because of drainage which is poor on account of the abnormal positions of the ureters. Then, too, the ureters

are often found bound together with fibrous bands. In one of our patients the ureter from the infected pelvis was definitely dilated above the point at which the ureters crossed, while below this point, both ureters were normal in size. Among the most common disorders found in such kidneys are pyogenic infection, stones, and tuberculosis. These may present considerable difficulty in diagnosis and treatment. A pyelitis in such a kidney may be intractable due to the poor drainage; because of this, surgical procedures are often undertaken. When stones are present a difficult surgical problem is presented because it often becomes necessary to determine whether it is better to do a nephrectomy, or to remove the calculi in combination with some plastic procedure.

In two of our patients with stones it was necessary to sacrifice a kidney; once because of the presence of a severe infection in the kidney and in the other, because of numerous calculi which could not otherwise be removed satisfactorily. In the third patient a most unusual and interesting problem presented itself and its solution was possible only by a most unusual operation. This case is reported in detail as Case VII in this series. The patient presented all the clinical symptoms of a stone in the ureter. On cystoscopic examination a ureteral catheter entered the ureter and gave evidence of a calculus about 20 cm. from the bladder. The injected fluid did not go beyond the shadow noted above, and it seemed that there was obstruction of the ureter by a stone and that there was nothing unusual about the case. At the operation by Dr. Lahey for the removal of the ureteral calculus, the usual extraperitoneal approach to the ureter was undertaken. When the ureter was found, however, it was impossible to discover any stone. The ureter was carefully followed from deep within the pelvis well up to the kidney and no stone was discovered. We were very certain, however, that a stone was present in the ureter and the possibility of a duplicated ureter was then suspected for the first time and further dissection undertaken. With this further dissection a second ureter was found and in it the obstructing calculus. The calculus was removed and the patient made a very satisfactory recovery.

Failure to recognize the possibility that a second ureter could be present and contain the calculus would have resulted in unsuccessful operation and failure to relieve the patient of his chief complaint.

When there are separate orifices in the bladder these are usually identified easily and catheterized at the time of the cystoscopic examination. If, however, the duplicated orifices are missed there are two main features about the pyelogram which make one suspect a duplication of the kidney. Thus, if a small incomplete pelvis is demonstrated by the pyelogram, with a large kidney shadow, or if there are shadows suggestive of calculi in the kidney area that are not included in the pyelogram, duplication is to be suspected. These points are clearly illustrated in Case II of this report. When the ureters join well up above, the bladder pyelograms are usually obtained when injection is made through the ordinary catheter drawn to a point just above the bladder. In some cases in which the juncture is very near the bladder it is possible to obtain a pyelogram by injection through a bulb catheter wedged into the ureteral orifice.

Case I.—The patient, a woman aged thirty-seven, was seen April 6, 1928, complained for several years of recurrent attacks of moderately severe pain in the right upper quadrant of the abdomen. The urine contained an occasional white blood-cell. General physical examination was negative. The Graham test showed normal filling of the gall-bladder. A pyelogram showed a duplication of the right kidney with mild pyelitis (Fig. 526).

Case II.—This patient, a woman of fifty-three, came to the clinic complaining of recurrent attacks of very severe pain in right upper quadrant, present for twenty-five years. Some of the attacks were accompanied by nausea and vomiting. The last attack had begun two weeks before admission, with pain radiating down the flank and to the groin. Nausea, vomiting, and fever were present. There was, however, no frequency nor pain on urination. Physical examination showed the patient to be well nourished, but acutely ill. The temperature was

103° F. Marked tenderness on right side of abdomen was elicited and was also present in the right costovertebral angle. There was in addition a rather large, tender movable mass in the region of the right kidney. The urinary sediment contained numerous pus-cells and a few red blood-cells. On cystoscopic examination, pus could be seen exuding from the right ureteral

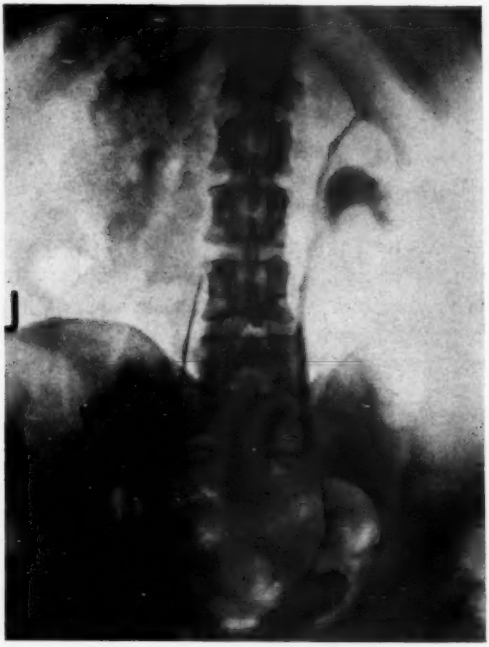

Fig. 526.—A rudimentary upper pelvis and ureter which amounts to nothing more than a very much elongated calyx. There is slight dilatation of the lower pelvis.

orifice. The urine from the left orifice was clear. The right kidney excreted no dye in forty minutes. The left kidney functioned normally.

Plain *x*-ray films showed numerous small dense shadows in the region of the right kidney. A duplication of the kidney was suspected because of the large palpable kidney with the small

pelvis (pyelogram) which did not contain all the shadows which were included in the shadow of kidney as seen in the plain film. At operation a pyonephrotic kidney, containing numerous small calculi, and duplicated pelves and ureters was found. Nephrectomy was performed (Fig. 527).

Fig. 527.

Case III.—A white woman, aged fifty-eight, was seen October 31, 1928, complaining of recurrent attacks of lower abdominal pain of many years' duration, with marked frequency of urination. Physical examination was essentially negative. The urinary sediment contained a rare white blood-cell. On cystoscopic examination both kidneys were found to function normally as determined by the intravenous indigo-carmine test. No pus was found in ureteral specimens. The kidneys were not clearly outlined in the plain *x*-ray film. Pyelograms were made

(Fig. 528). Symptoms did not improve with cystoscopic treatments.

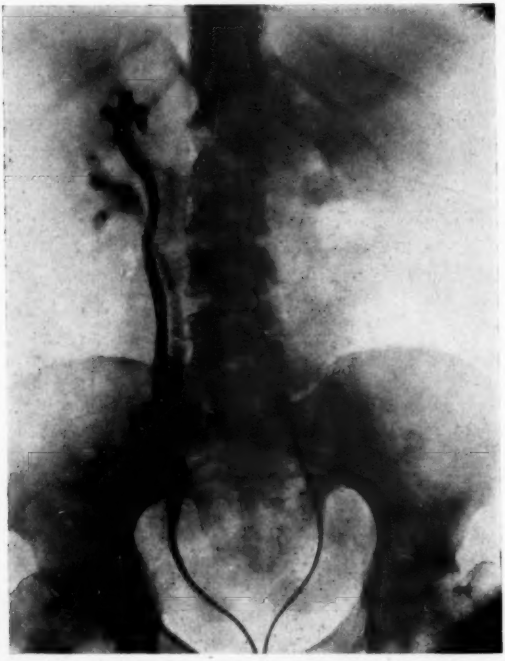

Fig. 528.—The pyelogram shows a duplication of the pelves and ureters, the ureters joining at the level of the lower border of the sacro-iliac joint. There is moderate dilatation of both ureters and slight blunting of the calices. Both pelves are filled by the injection of the upper ureter. A pyelogram on the right showed a normal pelvis and ureter.

Case IV.—A girl of twelve years came to the clinic complaining of recurrent attacks of dull pain in right lower quadrant. There were no urinary symptoms. There was slight tenderness to palpation in the right lower quadrant of the abdomen. Urinary sediment contained many white and red blood-cells. The *x*-ray film showed many dense shadows in the right lower quadrant which were thought to be calcified glands.

On cystoscopic examination two ureteral orifices were found

on the left side, while a single one was seen on the right. The orifice more distal from the bladder neck on the left was reddened and edematous. The specimen from this ureter contained a few pus-cells. The other ureteral specimens were normal. The pyelograms shown were made after the patient had completed the

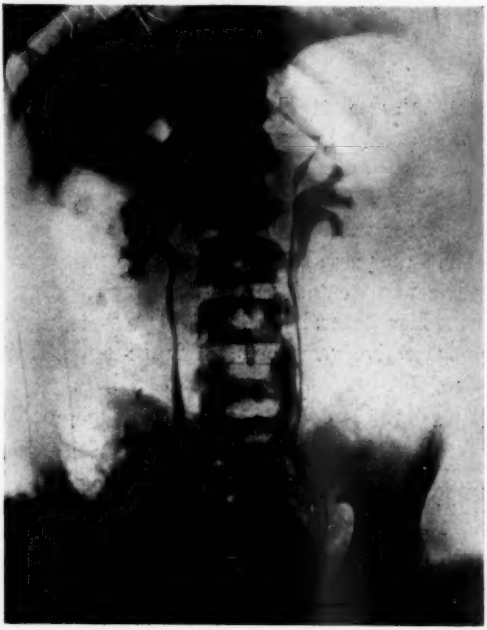

Fig. 529.—A single pelvis is seen on the right. There is a complete duplication of the pelvis and ureter on the left. The upper rudimentary pelvis is not infected. The lower is infected. The ureter is not completely filled, but sections of it can be seen, showing it to be considerably dilated.

treatment (Fig. 529). The first plate taken before treatment showed the dilatation to be much more marked.

The patient was given sodium acid phosphate and urotropin by mouth, alternating at weekly intervals with sodium bicarbonate. In addition, the infected pelvis was lavaged with $\frac{1}{2}$ per cent. silver nitrate solution on three occasions at one, two,

(Fig. 528). Symptoms did not improve with cystoscopic treatments.

Fig. 528.—The pyelogram shows a duplication of the pelves and ureters, the ureters joining at the level of the lower border of the sacro-iliac joint. There is moderate dilatation of both ureters and slight blunting of the calices. Both pelves are filled by the injection of the upper ureter. A pyelogram on the right showed a normal pelvis and ureter.

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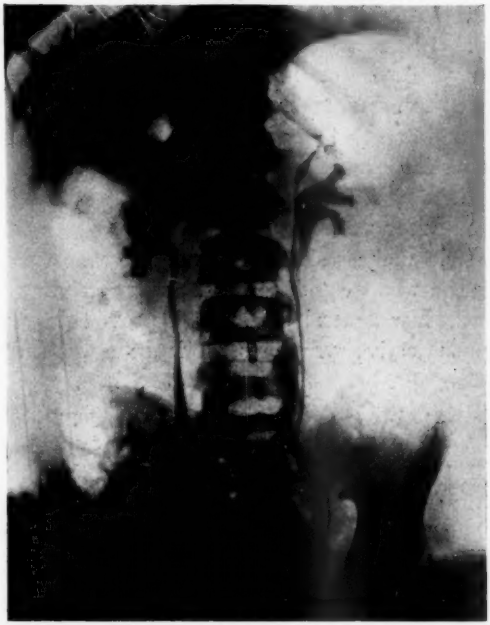

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The patient was given sodium acid phosphate and urotropin by mouth, alternating at weekly intervals with sodium bicarbonate. In addition, the infected pelvis was lavaged with $\frac{1}{2}$ per cent. silver nitrate solution on three occasions at one, two,

and three week intervals, at the end of which time there was only a rare white blood-cell in the bladder specimen.

Case V.—A white woman, aged twenty, was seen December 3, 1928, with a complaint of "stomach trouble." One year before she had had an attack of severe epigastric pain, followed by soreness in that region for two weeks. Shortly after the attack the urine showed macroscopic blood on two occasions. She then felt well until three weeks before coming to the clinic at which time she had a similar attack. The pain was not related to meals. Nausea, vomiting, and gaseous eructations were present. The general physical examination was negative except for undernutrition, and mild secondary anemia. There was an occasional white blood-cell in the urinary sediment.

On gastric analysis she was found to have an achlorhydria, for which she was treated, while she was receiving cystoscopic treatments. Her general condition improved greatly with relief of the subjective symptoms. The urine was free of pus on discharge.

Case VI.—A woman, aged thirty-two, came to the clinic January 3, 1929, complaining of pain in left flank, of about six months' duration. The pain was vague and did not radiate. There was slight tenderness to deep percussion over the left kidney posteriorly. The urine showed numerous white and red blood-cells. The function of the right kidney was normal while that for the left was considerably impaired. The plain *x*-ray film showed the right kidney shadow to be considerably enlarged. Within this shadow was one large and several small dense shadows. At operation, a large hydronephrotic kidney with a double pelvis and ureter was found. There was a large branching calculus in the lower pelvis and several small ones in each pelvis. Nephrectomy was performed. Recovery was uneventful.

Case VII.—A man, aged sixty-four, was seen June 15, 1929, complaining of a steady, severe pain in the left flank of three days' duration, with nausea, vomiting, and gaseous distention.

The urine showed a few white and red blood-cells. There was slight tenderness to heavy percussion over the left kidney posteriorly. On cystoscopic examination the right kidney was found to function normally. On the left side the ureteral catheter met an impassable obstruction at a distance of 20 cm. from the bladder. No dye came through the catheter on this side. An at-

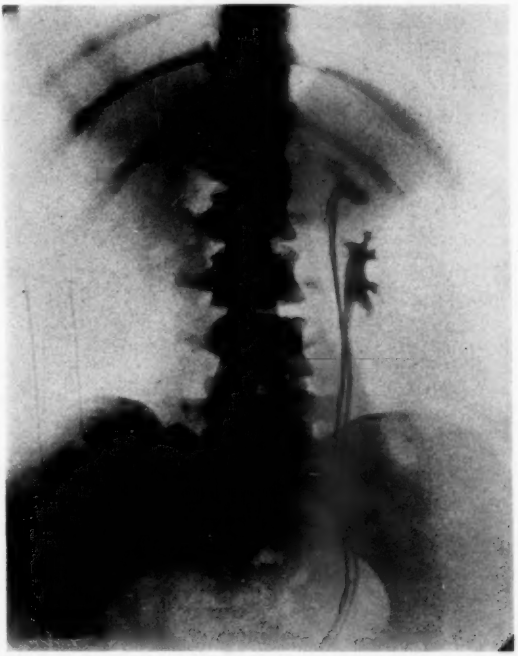

Fig. 530.—A complete duplication of ureters and pelves. There is slight blunting of the calices of the upper pelvis in which the infection was localized. The lower pelvis is not infected. Calices appear to be perfectly normal. Pyelogram of the opposite kidney showed a normal type of pelvis and calices.

tempt to make a pyelogram showed a filling of the ureter up to the level of the transverse process of the third lumbar vertebra where a dense small shadow was seen, evidently an ureteral calculus. A duplication of the ureters and kidney was not suspected.

Through a loin incision a ureter was exposed at the level of the pelvic brim. No stone was found in the ureter although it was searched from the kidney to a level just above the bladder. During this procedure the second ureter containing the calculus

Fig. 531.—Pyelogram of the right kidney is normal. On the left the catheter is in the ureter leading to the upper rudimentary and hydronephrotic pelvis. There is regurgitation of the iodid solution filling the other branch of the ureter and partially enveloping the calculi.

was discovered and the true nature of the condition was revealed.

Conclusions.—Supernumerary fused kidney is a very common anomaly. The condition offers considerable difficulty in diagnosis and treatment, and it should be searched for routinely at cystoscopic examinations.

LOW BACK PAIN FROM LUMBOSACRAL ANOMALY

G. E. HAGGART

Low back pain often combined with pain radiating down one or both lower extremities is one of the most frequent complaints encountered in an orthopedic clinic. The individual symptoms vary widely and the disability ranges from invalidism, or extended periods in bed with acute pain, to long-continued consciousness of a "weak back."

To determine the etiology is commonly difficult. Not infrequently there may be required a genito-urinary investigation, a gynecologic examination, and an orthopedic opinion. Of the patients coming within the latter field, those presenting lumbosacral anomalies form one group in which the findings and treatment are more clearly defined.

It is possible that one or more of these anomalies may be present without back symptoms at the time of the examination. But in the majority of such patients, I believe, careful inquiry will elicit a definite history of physical limitation, which on further analysis, indicates the patient is aware that low back symptoms will occur if certain strenuous exertions are performed. On the other hand, the patient may speak of always having a weak back with consequent limitation of activities. Patients frequently inquire why, if they were born with these defects, symptoms have not occurred at an earlier date in their lives. The answer lies, to quote Dr. Albert Ferguson,[1] in the term "compensation." In their earlier years the spine was more flexible and the muscular development more adequate, to compensate for the presence of a weak or unstable mechanism in the lower back. Muscles and ligaments have borne the load ordinarily taken care of by the osseous framework. Therefore, in this type of back the muscles and ligaments are nearer their capacity than would be the case

with a sound lumbosacral mechanical situation. It follows therefore that this muscle and ligamentous reserve may be used up more readily than in the case of a normal back. In consequence of the patient's being decompensated it becomes progressively more difficult for the muscles to recover that equilibrium or state which is compensation. It is for this reason that patients so commonly ascribe the onset of symptoms to some trauma. With this additional factor the muscle and ligamentous reserve is wiped out, and permanent decompensation sets in. I feel that the presence of the anomalies described below result in a potentially weak or unstable mechanism at the lumbosacral joint, which eventually causes symptoms. Once the pain and disability begin they tend to persist with recurring exacerbations. In many cases the sciatica so commonly present is the chief complaint, and the one for which they seek relief. The term "sciatica" is merely a symptom. It is not a diagnosis.

Theodore Willis[2] has shown that in primates there is a progressive shortening of the vertebral column, and that the human column, while not constant in the number of segments, is more stable than those of the anthropoids. This progressive shortening is accomplished by movement of the ilia upward on the lumbar segments. Therefore, the presence of anomalies is the result of intermediate stages of the absorption of the last lumbar vertebra by the sacrum. Furthermore, these variants always occur in special relationship to the lumbosacral articulation. As an instance of their frequency of occurrence Moore[3] reports that in an examination of some 3640 *x*-ray films, lumbosacral anomalies, particularly sacralization, were found in 61 per cent. of all patients with low back symptoms.

Von Lackum[4] stressed the essentially unstable mechanism of the lumbosacral joint:

1. It is the junction of a mobile and immobile part.

2. The usual means of joint stabilization are at marked disadvantage because this structure was originally designed for progression on all fours.

In the prone position since the lumbar lordosis is omitted, the sacrum is the key-stone of an arch set in between

the ilia and so may be regarded as simply a direct continuation of the spinal column. In the upright posture, however, the lumbar lordosis causes the pelvis to tilt forward and downward. Hence the front or inferior sacral surface faces the ground while the posterior or superior sacral surface looks upward and backward. In man this lumbosacral articulation is often the site of a tremendous shearing strain illustrated by the tendency of the fifth lumbar body to slide forward and downward. This strain is particularly marked because the fibrous disk between the fifth lumbar and the first sacral vertebra is normally one of the thickest in the entire column, and consequently permits considerable movement between these adjacent vertebra. Finally, this junction may be the site of a rotary action because of asymmetric variation in the planes of the articulating lumbosacral facets.

In taking up the anomalies found in the lumbosacral area they are best discussed after the classification of Willis[5]:

1. *Defects in the last presacral vertebra:*
   (*a*) Split or separate vertebral arches.
   (*b*) Variation in size of the transverse processes.

2. *Anomalies of articular facets between the last lumbar and the first sacral segments,* with which is frequently associated an abnormally acute lumbosacral angle.

1. **Defects of the Last Presacral Vertebra.**—(*a*) *Split vertebral arches* or *spina bifida* is easily recognized and often seen by the *x*-ray examination. Willis,[5] in 1913, found 0.2 per cent. in 850 anatomic subjects. While in a series of 748 skeletons there were 31 specimens with separate vertebral arches or 4.38 per cent. Symptoms from this abnormality are not commonly reported.

Fragmentation of the vertebral arch may occur at any point along the laminæ, or at the pedicle where the vertebral arch is attached to the body. In the latter instance by grasping the exposed spinous process, adjacent ligaments having been dissected away, it is sometimes possible to freely move, or actually withdraw, the entire neural arch. This separation of the neural arch not infrequently occurs in the laminæ between the superior

and the inferior articular processes. In such an instance the bony anchors of the fifth vertebral body to the spine, that is, the spinous and inferior articular processes, are absent. Bearing in mind the forward sloping platform of the sacrum and the shearing strain present in this region, it is easy to postulate what will occur—indeed what does occur, namely, forward dislocation of the body of the fifth lumbar vertebra. Clinically the resulting deformity is known as spondylolisthesis—a term originally employed by Killian in 1854. With an analysis of 101 cases Neugenbauer[6] in 1892 presented the first comprehensive summary of this deformity. Neugenbauer believed spondylolisthesis to be due to the lack of union between two ossification centers in each lamina. Definite proof of the existence of such centers is still in doubt. Emphasizing the many and varied sites of these defects, Willis[5] suggests the anomalies are the result of developmental defects, that is, areas of failure of bone growth in the arch.

Symptoms in spondylolisthesis are due to:

(1) Injury to the ligamentous structures binding the neural arch to the vertebral body, and to those ligaments which maintain the relationship of the fifth lumbar vertebra to the sacrum and ilia.

(2) Pressure on spinal nerves, either while in the intervertebral canal or while passing anteriorly to the lumbosacral articulation. Such nerve irritation may involve spinal roots from the fourth lumbar nerve downward. Actually the root of the fifth lumbar nerve is more frequently affected. The first sacral nerve may be involved. Danforth and Wilson[7] have shown that while the fifth lumbar nerve is the largest of the lumbar series it passes through the smallest intervertebral canal. Furthermore, while in the foramen it passes directly anterior to the facets of the fifth lumbar and the first sacral vertebræ. On emerging, the nerve lies in direct contact with (*a*) the lateral margin of the inferior surface of the fifth lumbar vertebral body, (*b*) the intervertebral disk, and (*c*) the lateral margin of the superior articular surface of the sacrum. Therefore, the leg symptoms in such a case would be pain referred along the cutaneous distri-

bution of this nerve over the anterior lateral aspect of the lower leg, the lateral aspect of the foot, and sometimes the dorsum of the great toe. If the first sacral nerve is also involved pain will be present along the posterior aspect of the calf and heel, and the plantar surface of the foot.

(*b*) *Variation in Size of the Transverse Processes.*—The second group of these patients presents variation in size and form of the transverse processes of the last lumbar segment. The *x*-ray films reveal an attempt on the part of these processes to impinge upon or become fused to the lateral sacral mass. In the former type, if they are distant from the sacrum no symptoms may result. If the processes are relatively close to the lateral sacral mass and, as so often is the case, form a joint there, it is described as an incomplete sacralization. While, when bony union occurs, sacralization is then termed "complete." This anomaly may be present upon one or both sides.

In the instances in which sacralization is complete on both sides I doubt if the anomaly causes symptoms. The incomplete form, however, according to Goldthwaite,[8] "introduces another joint, which because of unnatural mechanics involved is particularly apt to strain." In a series of 1104 consecutive *x*-ray examinations of the spine, Moore[9] found sacralization in 3.35 per cent. He believes that the percentage of occurrence in patients with low back pain is double this figure.

Patients with incomplete sacralization in addition to the usual back symptoms commonly complain of considerable pain on pressure over the iliolumbar angle. Leg symptoms may not be a frequent finding, but when present the pain is often referred to the anteromesial aspect of the lower leg corresponding to the distribution of the fourth lumbar nerve. Since this nerve after leaving the lateral aspect of the disk between the fourth and the fifth lumbar bodies lies over and anterior to the fifth transverse process. Not infrequently, in these cases, there may also be pain referred along the distribution of the fifth lumbar nerve. Finally a unilateral sacralization may and often does cause a lumbodorsal scoliosis.

2. **The Final Group Comprises Anomalies of the Articular Proc-**

esses Between the Last Lumbar and the First Sacral Segment.—I believe that the most efficient mechanical relationship of the lumbosacral articular facets is when the articular surfaces face internal-external; in other words, laterally. While in the most unstable type the facets face anteroposteriorly and are of a wide, shallow formation. As actually seen in the *x*-ray films and at operation there are all degrees of variation from the above. Very commonly asymmetry is present, in which event a rotary motion occurs, the more stable facet acting as a fulcrum. In this type, erosion of the adjacent posterior surface of the sacrum frequently results, and is often visible in the *x*-ray film. If an abnormally acute lumbosacral angle is also present marked shearing strain results and further aggravates the back pain.

Because of mechanical instability and resulting ligamentous strain, low back symptoms develop, and because of the close relationship of the adjacent nerves, notably the first sacral and fifth lumbar, pain in the leg along their distribution is often present.

Diagnosis.—It is to be understood that in all low back cases every effort has been made to rule out causes of pain extraneous to the spine and to the bony pelvis.

The necessity of a detailed history and careful physical examination is obvious. It is essential to determine accurately the locality of the back pain and to map out the areas of pain distribution in the lower extremities. A difficult differential diagnosis is between pain of lumbosacral origin and the symptoms of sacro-iliac disease. In this connection, Smith-Peterson[10] has described a most comprehensive examination technic. Another very helpful diagnostic aid is to successively inject with 2 per cent. novocain the nerve-roots which supply the lumbosacral and the sacro-iliac regions. This procedure is based on the established fact that sciatic radiation of pain occurs following abnormal lumbosacral mechanics and also from sacro-iliac arthritis and strain. The proof of successful nerve-root injection is confirmed by anesthesia over its peripheral distribution. After the injection the examination is repeated and if the previous symptoms are less marked—or as may be the case entirely

absent—we have evidence that the anesthetized nerve-roots are the source of the symptoms. For example, relief following blocking of the fifth lumbar and first sacral roots—points to the lumbosacral junction as the causative area. While if blocking the second sacral nerve lessens discomfort and successive similar injection of the first sacral gives relief, the sacro-iliac joint is the source. Obviously, in a given case, all these nerve-roots, either singly or in pairs, should be injected on different days to complete a careful differential study.

The diagnosis in these patients with low back pain eventually depends to a considerable degree upon the *x*-ray examination. It is, therefore, most essential that satisfactory views be obtained. In this clinic the following films are taken, in each instance centering on the fifth lumbar vertebra: An anterior-posterior stereoscopic, a lateral, and a 45-degree angle. The latter film is of particular benefit in revealing the joint relationship between the fifth lumbar and first sacral vertebra. This plate will also clearly define the relationship of the fifth lumbar transverse processes to the lateral sacral mass.

Treatment.—In patients with spondylolisthesis repeated attempts to give relief by conservative measures have not been successful. I believe there is only one adequate treatment, namely, a fusion operation, which usually includes the fourth and fifth lumbar and first sacral vertebræ. The Hibbs[11] technic is, in my opinion, the best anatomic and physiologic procedure to obtain arthrodesis.

Cases Presenting Sacralization.—The choice of treatment depends upon several factors. The more important are the duration and severity of symptoms, and the degree of sacralization. In milder cases, conservative treatment often may relieve the symptoms. This consists of such measures as posture correction, low back belts or braces, massage, and exercise.

Not infrequently after a period of comparative freedom the patient may seriously injure the back and then symptoms recur, and conservative treatment fails to return the patient to a normal active life. In such cases, operative measures may well be indicated. Some surgeons prefer to remove the transverse

process and report marked relief by this technic. Personally, I favor fusion of the fifth lumbar and the first sacral vertebra. Such a procedure stabilizes the transverse process and also places at rest the unstable articular facets so often seen in cases of sacralization.

Anomalies of Articular Processes Between the Fifth Lumbar and First Sacral Vertebræ.—In these patients, there is an even wider variation in the clinical picture. Conservative measures, as noted above, should always be attempted first. In many instances, exercises designed to develop the back muscles and to maintain a correct posture are all that is necessary. Particular emphasis should be laid on development of the gluteal musculature. By proper function of this group the forward pelvic tilt and increased lumbar lordosis with consequent "hollow back" deformity can be overcome.

Occasionally these corrective measures bring about only a temporary improvement. Such a patient commonly presents a long history of progressively increasing frequency and severity of attacks, and *x*-ray examination reveals symmetric articulations with rotary movement and sacral erosion—that is an unstable fifth lumbar vertebra. Often with such a history and clinical findings but particularly when there is associated shearing strain from an abnormally acute lumbosacral angle, I believe a fusion of the fifth lumbar to the first sacral vertebra offers the best treatment.

BIBLIOGRAPHY

1. Personal communication.
2. Willis, Theodore: Amer. Jour. Anat., 32, 95, 1923.
3. Moore, B. H.: Jour. Bone and Joint Surg., 5, 212, 1923.
4. Von Lackum, H. L.: Jour. Amer. Med. Assoc., 82, 1109, 1924.
5. Willis, Theodore: Surg., Gynec., and Obst., 38, 658, 1924.
6. Neugenbauer: Spondylolisthesis et spondylize, 1892, Paris.
7. Danforth and Wilson: Jour. Bone and Joint Surg., 7, 109, 1925.
8. Goldthwaite, J. E.: Jour. Bone and Joint Surg., 2, 416, 1920.
9. Moore, B. H.: Jour. Bone and Joint Surg., 7, 271, 1925.
10. Smith-Peterson: Jour. Bone and Joint Surg., 6, 819, 1924.
11. Hibbs, R. A.: New York Med. Jour., May 27, 1911. Jour. Amer. Med. Assoc., 71, 1372, 1918. Archives of Surg., 4, May, 1922.

POSTOPERATIVE EDEMA

O. J. MENARD

THE etiology of postoperative edema is often obscure. A careful investigation as to the various factors that may produce edema will often clarify the situation, but frequently there may be one or more contributory causes present, so that the clinical picture may be confused. Treatment thus becomes empirical in many cases.

The benefit derived from large amounts of fluids is so great that its administration should not be discouraged. In certain instances, however, extensive edema has apparently resulted from forcing fluids without any other obvious cause being present. The clinical differentiation of the various types will be presented and their treatment discussed.

(*a*) When edema of the legs is the result of a myocardial insufficiency, a definite diagnosis should be made only in presence of the clear cut signs, *i. e.*, orthopnea, congested neck veins, and enlarged liver. In extreme cases, dyspnea may be present at rest, but rarely cyanosis. In our experience uncomplicated congestive heart-failure after operation is very rare. Postoperative infection, more commonly of the pulmonary type, is presumably a precipitating factor. If the infection can be overcome the prognosis is usually good for the immediate future. Treatment should be the limitation of fluids, digitalis, and later diuretics should be given if needed. Intravenous or intramuscular injection of digitalis is indicated in auricular fibrillation if distress is acute, otherwise oral administration is satisfactory. The equivalent of 10 to 15 grains of any reliable intravenous digitalis preparation can be administered in two doses at six-hour intervals. By far the best oral diuretic in our experience has been theocin, given in 5, 10, or 15 grain doses. This may be repeated daily if

no unpleasant symptoms appear. We have found salyrgan to be the safest and least toxic of the intravenous mercurial preparations. Care should be taken not to allow the latter drug to get outside the vein as a serious slough may develop.

(*b*) Acute nephritis with edema is a rare postoperative occurrence. Edema here, of course, is easily distinguished from other forms by its location and by the evidences of acute nephritis in the urine examination. More commonly a latent chronic nephritis may become apparent as the result of postoperative infection. If not associated with nitrogen retention in the blood, diuretics may be used cautiously, in case the restriction of fluids and diet do not relieve the edema.

(*c*) The part the heart and kidneys play in hypertensive and arteriosclerotic patients who develop edema is often difficult to determine. At times there is no definite evidence of failure and the kidney tests are often within normal limits. Usually these patients are over fifty years of age. All one can say is that these patients are unable to eliminate the large quantities of fluid administered. It is possible that salt retention plays a part. If 3000 c.c. of normal saline solution are given daily for two or three days after operation, the intake of salt approaches 30 to 40 gm. daily. With the additional burden of infection, in many of these patients the kidney function is undoubtedly impaired in spite of the fact that clinically the functional tests are inconclusive. Limitation of fluids will often be sufficient to reduce the edema but diuretics have been necessary in some cases.

(*d*) There is a group of patients who have rather severe anemia at the time of operation either due to their disease—such as malignancy or possibly due to preoperative starvation, that develop edema postoperatively. At times a definite history of food deficiency is obtainable, especially in the animal proteins. These patients may have a moderate grade of generalized edema which cannot be accounted for in the heart or kidneys. This group will often be benefited by a liberal diet as soon after operation as possible, and particular attention must be paid to the ingestion of a large quantity of animal protein. Improvement is frequently hastened if liver and iron are added to the diet. The

edema may disappear rather rapidly, but the anemia improves much more slowly.

(*e*) Massive edema of one or both legs occurs at times. This may be due to phlebitis, thrombosis, or compression of the veins by new growths. The degree, extent, duration, and prognosis depend upon the process. The most extensive edema which at times may seem hopeless will often disappear without treatment, while on the other hand, the slight ones may persist indefinitely. Treatment is palliative.

Summary.—Postoperative edema occurs frequently but only occasionally is due to frank myocardial or renal insufficiency unless there is a superimposed infection. When failure appears, treatment directed toward the heart and kidney is often efficacious. In a large number of cases the cause of edema is not clear as there may be many factors involved which confuse the clinical picture. The excessive administration of fluid and salt solution may be associated with this phenomenon. The fluid intake should be limited and diuretics given if necessary. Anemia at times appears to be related to postoperative edema. Venous obstruction at times causes edema which may persist or may disappear spontaneously.

Conclusion.—Infection apparently plays the major rôle in precipitating postoperative edema. Excessive administration of fluid and salt solution may be followed by edema with or without infection.

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